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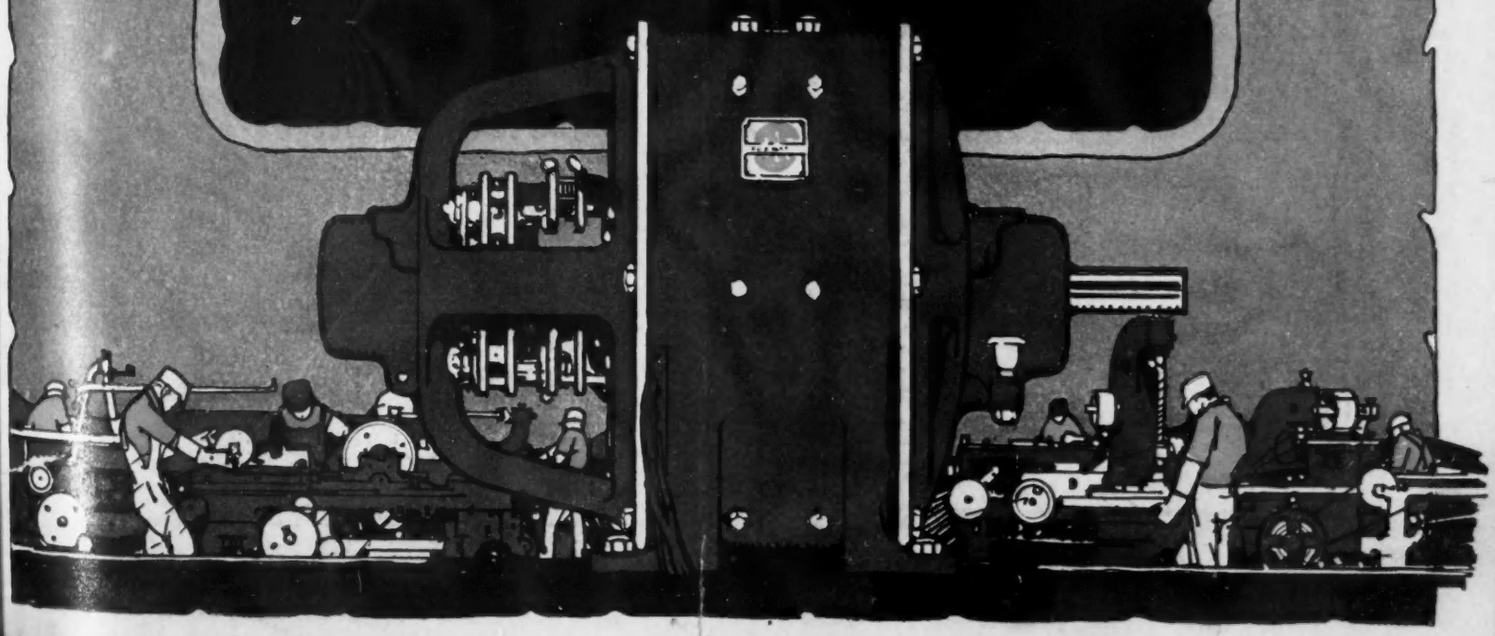

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Electrical World

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Daylight Saving

WHO would have thought that so simple an expedient as daylight saving would be attended with such confusion? In the contention between the farmer and the city dweller daylight saving seems to be having a hard time of it. "A plague on both your houses!" say public utilities, which must serve both.

Jobbers' Service

A PROMINENT electric supply jobber gives an excellent epitome of the present situation in that field. "We are no longer selling agents for manufacturers," he says, "but purchasing agents for customers. Instead of carrying a warehouse stock and selling it, we take orders from our customers and go out in the market and try to buy the goods they want." And yet some people maintain a jobber does not render service!

Capitalizing Present Expenditures

THE present abnormal market conditions bring a new obligation to regulating commissions that scrutinize utility expenditures—one which must be squarely met. Deliveries on materials required by the central stations are so long and uncertain that the utilities often have to place their orders for supplies and apparatus as much as a year in advance in order to be prepared to meet the estimated requirements of their customers. This may mean that the utilities have paid more for their material and apparatus than subsequently may be found to have been necessary. However, the central stations should not be called upon to speculate on prices. It is much better that the public shall be able to get service when it is needed than that it be deprived of service because the utility management is waiting for prices to drop. The companies should be ready to serve the communities in which they operate, and the controlling commissions should approve the expenditures which such a policy entails.

Electric Furnace Rates

ELECTRIC furnaces have made possible such economies to users that the amount of the power bill is of small moment. The net result is that the electric furnace can very well afford to pay rates approximating those paid for lighting service, since the value of the service is such as to command those rates. On the Pacific Coast at the present time plans are being made to increase the electric furnace load enormously. One single plant is planning to add 30,000 kw. in furnaces as quickly as the electric energy can be provided. Others are contemplating smaller increases. The field for furnaces to melt scrap in small establishments is growing so rapidly that the total furnace load promises to be of considerable magnitude. Power companies should therefore establish a rate for this business based on the value of the service furnished. Such a basis has been successfully tried in the Nevada gold fields, where the rate fluctuated with the value of the ore recovered.

Department of Public Works

BY ALL means let's have a national department of public works to supervise the engineering work of the country, and let it be manned from top to bottom with engineers. Lawyers may make good referees and receivers, but with engineers on the job there will be very little to adjudicate, and as for receiverships, failures will be so few that the title of receiver will become obsolete.

Light, Power and Stock Dividends

ALL dollars looked alike to utility managers at one time, but today the far-sighted executive seeks to enroll local funds even in small amounts for needed developments in plants and lines. This method of bridging the gap between the so-called public on the one hand and the company on the other has developed a new influence on local opinion when company problems are being discussed, an influence that cannot be exercised by a distant investor who may be many times more heavily committed financially. This new public policy not only opens the investment door to the thrifty customer and employee but extends the meaning of the term service to them to include light, power and stock dividends.

The Factory Electrical Engineer

WHILE there is a growing recognition of the value of the electrical department in mills and factories, even yet the managements frequently do not assign to this department the broad field that it deserves. Very often the man who is charged with the responsibilities of proper utilization of electrical energy and electrical maintenance in the plant will be found in an unsightly office in the repair shop. Here his entire time is taken up with the never-ending petty details of maintenance—details that might better be left to the handling of a subordinate foreman. The large problems of economies, proper selection of equipment and general policy of the department are, under such a system, neglected in the mass of detail connected with operation. Since the possible economies of a well-organized electrical department show up in a reduction in cost of product through increased production, the head of this department should occupy a position on a par with the works manager, or at least a first assistant, with an office in the section devoted to executive work. Instead

of bearing the non-descriptive trade designation of chief electrician, he should carry the title of mill, factory or works electrical engineer and possess the experience that merits this title. A man of no unusual qualifications so situated and studying the economies of production from the standpoint of electrical operation can justify a very attractive salary in possible annual savings even in a moderate-sized plant.

Problems of Turbo-Generator Design

AN IMPORTANT paper by J. Shepherd before the (British) Institution of Electrical Engineers, dealing with the practical difficulties of design encountered in large turbo-generators, was abstracted in our Digest of Electrical Literature on March 6. As generators have grown bigger higher steam economy has been attained, but at the expense of grave mechanical difficulties. Mr. Shepherd directs particular attention to the formidable mechanical stresses induced in the rotor coils by the high peripheral speed which has to be reached even at best. It has been the practice to reduce this speed as far as possible by cutting down the rotor diameter and increasing its length, which again leads to mechanical difficulties. As an example of the magnitude reached by such stresses Mr. Shepherd points out a case in which the pressures at the exterior of the rotor coil rise to 4,600 lb. per square inch (320 kg. per sq. cm.), implying a very severe pressure strain on the insulation. Still further electrical difficulties may follow the imposition of such serious pressures.

In the stator there has been constant difficulty with the stresses set up by short circuit or under sudden variations of load, straining of the insulation and its ultimate failure ensuing as a result. The usual form of design, with considerable length and relatively small diameter, makes cooling increasingly difficult and the provision of the proper air supply troublesome. As a remedy for some of these difficulties Mr. Shepherd has some interesting suggestions. First of these is the ordinary one of provision of better insulation from a mechanical standpoint, a subject which is being continuously investigated. In particular, he attaches importance to a change in the customary methods of cooling and very strongly recommends water cooling, as in transformers, the circulation extending through both the rotor and the stator with particular attention to the end coils of the latter. He figures that a substitution of water for air cooling would lead, as indeed it does in the case of transformers, to a very considerable increase of output, which he estimates at 20 or 25 per cent. In plants working at rather high altitudes the difference would be more even than this. Of the effectiveness of such water cooling, if well carried out, there can be very little doubt. It involves, however, some inherent mechanical difficulties, and its success would depend on rather large modifications in design, the effect of which cannot be readily reckoned. It would be exceedingly interesting to have the water-cooling problem thoroughly worked out, but to get convincing results this would have to be done on a considerable scale, since its difficulties, like all others associated with turbine design, increase with added output. The plan certainly looks promising, although its execution might involve complications.

Divide Loads and Reduce Losses

THOUGH it is a well-known possibility, the advantage of economical division of a load over several lines seems worthy of renewed attention. In a short article which appears in this issue Lansing W. Thoms gives a mathematical solution of the economically correct division of load to be aimed at, as well as a concrete example of what the application of the solution can produce. The example chosen is one taken from everyday central-station life, and the magnitude of the possible saving is well worth pondering over. Such an example brings up vividly the importance of the energy loss on lines that carry heavy and continuous loads and shows what a large return investigation of this nature will pay to those that will spend the little time necessary to obtain the data and to determine what division of load should be made. Furthermore, throw-over service is becoming more and more a necessity to the industries depending on our central stations. Many throw-over lines are idle while the so-called operating lines are handling large blocks of power. Would not oftentimes large savings be obtained from carrying some load both on the operating line and on the throw-over line and depending on one line for the service only in case of breakdown?

The Pending Patent Bill Should Become Law

A BILL is now pending in Congress to bring the United States Patent Office to a reasonable degree of efficiency by adding moderately to the personnel and bringing the salaries paid to a point where they will at least give some encouragement to competent men to stay in the government service. The situation in the Patent Office is much the same as that in the Bureau of Standards, to which we have more than once had occasion to refer. Notwithstanding that the Patent Office is one of the few departments of the government which have rather consistently shown a surplus instead of a deficit, salaries have been so inadequate that sixty of the examining force have resigned since the first of last May and found outside employment at largely increased remuneration. Many of this number were men of long experience whose services were exceptionally valuable. It is the same story through all the departments. There is a constant drain of good men outward into the professions and the industries—men who can in time be replaced, but only after a long period of training in the peculiar duties of the several offices. This means a loss of efficiency in the service.

The bill now before Congress is the result of drafts by the exceptionally learned and skillful patent committee of the National Research Council and bears the indorsement of a great and notable body of inventors, patent lawyers and men of affairs. It has already passed the House and lies before the Senate for action. The net increase in the force is about 10 per cent, the total net increase in salaries only about half a million dollars. We believe that in the promiscuous hurling about of public funds this moderate amount should find lodgment in the department which represents in so distinctive a manner the industrial growth of the country. At present the Patent Office is fairly swamped with matters demanding immediate attention, and it has no force adequate to meet the requirements. The situation is unfor-

tunate in the extreme, and unless quick relief is given it will go from bad to worse until the office will vie in dilatory pre-eminence with the traditional court of chancery. The Senate should lose no time in ratifying the measure now before it. It can do so all the more cheerfully since it is proposed fully to cover the additional cost by slight added charges within the office.

Iron-Nickel Alloys and Their Properties

JUST as mechanical engineering is in large measure the science and art of utilizing the mechanical properties of steel, so electrical engineering may be likewise described as the science and art of utilizing the electromagnetic properties of steel. Without steel we should have very little mechanical engineering, as we now understand that term, and, again, without steel electrical engineering would be greatly restricted. With steel dynamos, motors, transformers and electromagnets all become available. The subject of the possible electromagnetic improvement of steel is of great industrial consequence. The bulk and cost of a dynamoelectric machine of given output depend mainly upon four constants of material—namely, the mechanical strength of the structure, the electrical conductivity of the winding, the electric insulation of the dielectric and the magnetic saturation of the steel, particularly of the steel teeth. Any available increase in these four constants, or in one of them, tends to diminish the size and cost of the machine.

In an article in this issue on the properties of iron-nickel alloys T. D. Yensen describes the results obtained in an important research directed to increasing the available magnetic conductivity of the steel used in constructing electrical machines. It is pointed out that an alloy of iron and cobalt, in the proportions represented by the formula Fe_2Co is capable of adding materially to the magnetic flux density which can be carried by the pole teeth of stators and rotors. This, however, is an expensive alloy, and inquiry has been directed experimentally to the question whether a nickel-iron alloy could be found with similar properties.

The results described do not indicate any appreciable gain in the magnetic conductivity of nickel-iron alloys over pure iron or open-hearth steel. Certain other useful magnetic properties have, however, been revealed in the nickel-iron alloys. Moreover, the results indicate that a definite combination or critical association is produced when the ingredients in the alloy are such as correspond to the formula Fe_2Ni, namely, at about 34.6 per cent of nickel and 65.4 per cent of iron. In the neighborhood of this composition, as the nickel content is gradually increased, the electrical and magnetic properties of the alloy undergo very marked and sharp changes, although the resulting properties are not nearly so useful as when cobalt replaces nickel in the alloy.

It is interesting to notice that as the amount of nickel in the alloy increased from zero to 100 per cent, or from pure iron to pure nickel, the specific gravity of the resulting metal increased steadily from 7.9 to 8.93 and did not reveal any sharp variations at critical values in the component ratios. This tends to show that the conditions which determine the electrical and magnetic properties of the material are submolecular and perhaps subatomic. From a scientific viewpoint the results set forth in the article are valuable and we are all indebted to the laboratory which supplies them.

Rebuilding Old Equipment

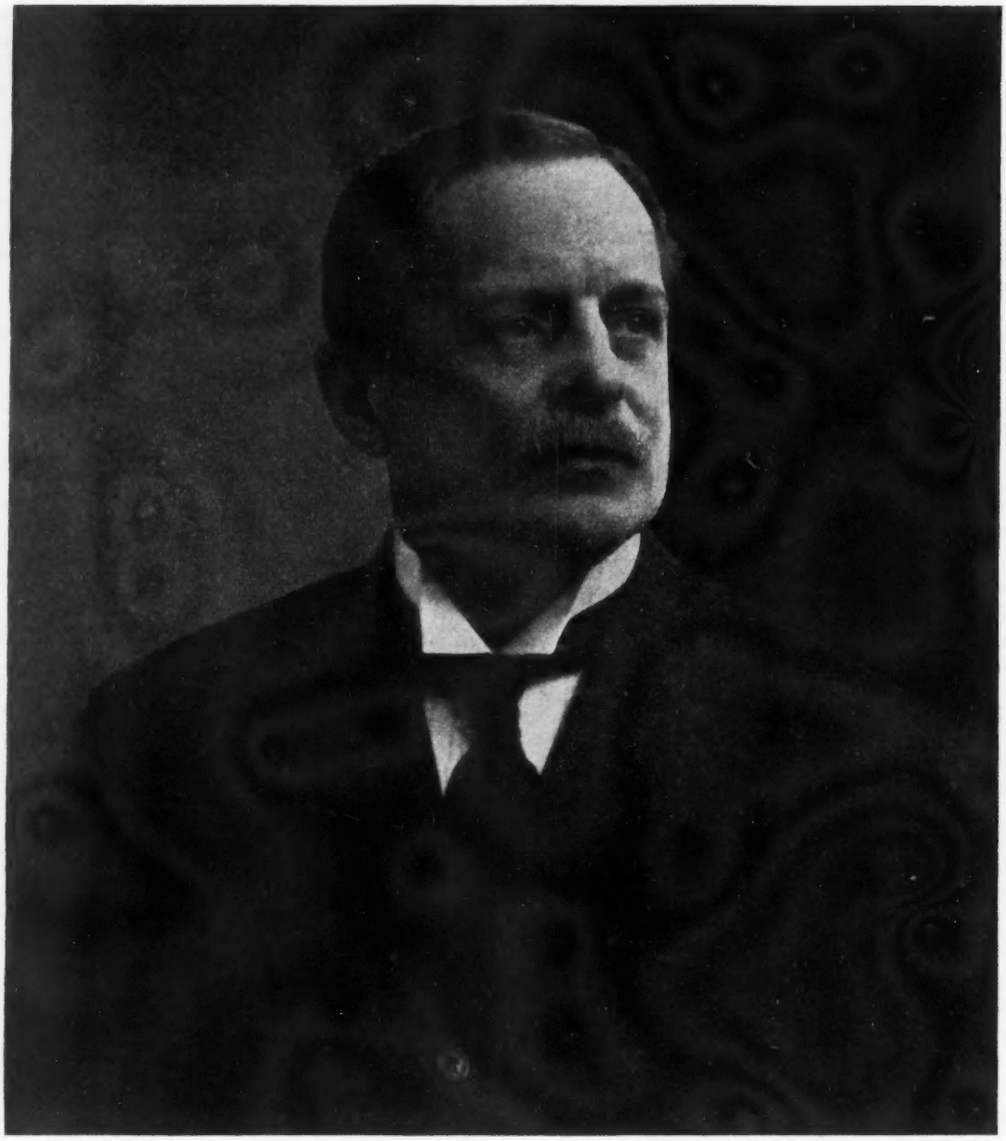
IF ALL equipment were perpetually new and depreciation were only an idle fancy the work of the industrial electrical engineer would be a simple matter of routine. But equipment becomes obsolete, unusual operating factors arise that cause rapid depreciation, breakages take place, designs may be at fault—and so life for the industrial man becomes a series of ingenious schemes to overcome difficulties. In this issue James Dixon describes the methods used in repairing 150 direct-current motors to put them in better shape to meet the severe operating conditions of a steel mill. Repairing motors is only one of a large number of the electrical problems that exist in a large mill or factory where the works electrical engineer has proved himself and his position an economical factor not only from the standpoint of a trouble mender but as well from the standpoint of a trouble preventer and therefore an exponent of increased production.

Triple Harmonic Frequencies in Three-Phase Systems

ONE OF the many remarkable properties of an iron-cored alternating-current transformer is that it is a generator of harmonics. When it is excited from a source of the frequency of say 60 cycles per second it will develop automatically a series of higher harmonics. The most prominent of the series, however, is the triple-frequency harmonic of 180 cycles per second. An explanation for this remarkable fact is found in hysteresis. The current excitation values necessary to increase the magnetic flux in the steel core are considerably larger than those required for demagnetizing, or bringing the flux back to zero. Consequently the exciting current necessary to produce a sinusoidal voltage and flux will be dissymmetrical in its rise and fall and so will not be sinusoidal. On the other hand, if the exciting current is forced to be sinusoidal, the flux and the voltage thereby generated in the windings will not be sinusoidal.

D. I. Cone in an article elsewhere in this issue discusses the average magnitudes of triple harmonic frequencies in three-phase systems under ordinary conditions of operation. It is pointed out that the triple harmonic component current in the excitation of modern transformers is commonly between one-third and one-half of the total current excitation, so that the triple-frequency excitation component is usually about 2 per cent of the rated load current. If, on the other hand, this triple-frequency excitation is suppressed or prevented from flowing, a triple-frequency component of voltage will appear on open circuit in the circuit of the transformer to the extent of about half the fundamental voltage. These magnitudes indicate the importance that the triple harmonic frequencies may develop in the action of a three-phase transformer system.

If the three transformers of a three-phase bank are connected in delta, the triple harmonic component of current excitation will travel in a closed loop around the delta. This may almost prevent the appearance of the triple-frequency harmonic in the external system, but it will warm up the delta transformers. If, on the other hand, the transformer bank is connected in star, with a grounded neutral, the triple harmonic current will seek to establish itself in this connection. The article will interest transmission and telephone men.



Elihu Thomson

An originator of the series arc-lighting system, a pioneer in alternating-current design, and an inventor of remarkable depth and range of scientific knowledge

FOR more than forty years Prof. Elihu Thomson has enriched the electrical industry as an inventor, an engineer and a savant. His practical ideas drawn from experimentation and research, his insatiable interest in science and his comprehension of electrical needs have yielded contributions of fundamental importance to the welfare of humanity the world over. After securing patents for his series arc-lighting system, he gave up a professorship in chemistry at the Central High School of Philadelphia in 1880 and, with the late Prof. Edwin J. Houston, moved the business of the American Electric Company to New Britain, Conn., where it became known as the Thomson-Houston Electric Company. In 1883 a further removal to Lynn, Mass., took place. Here a large business developed which was merged in 1892 with the Edison General Electric Company to form the present General Electric Company. Because of this consolidation the Thomson-Houston Electric Company has contributed two prominent presidents to the resulting company, C. A. Coffin and E. W. Rice, Jr. Since then Professor Thomson has been retained as their consultant. To him have been issued some 700 United States patents, of which 550 have covered electrical apparatus. His first important invention was the three-coil arc dynamo with an automatic regulator, a design with armature coils spaced 120 deg. apart which in structure was a three-phase alternator. In 1881 experiments with a magnetic field to interrupt an electric arc produced a horn lightning arrester and magnetic blow-out switches, and in 1883 came his reactive coil for controlling alternating currents and his idea of grounding the secondary circuit. In 1886 he was working on electric welding, and two years later he proposed the use of oil for insulating and cooling transformers. The induction regulator and single-phase repulsion motor he invented about this time. Later followed experiments and inventions covering current transformers, electric meters, the high-frequency generator, stereoscopic X-ray pictures, time-limit switches, multiple-unit train control, the resistance electric furnace, steam and oil engines, optics and acoustics.

Many learned societies have honored Professor Thomson, and he has served as president of the A. I. E. E., of the International Electric Congress and of the International Electrotechnical Congress. For some years he has been a member of the corporation of the Massachusetts Institute of Technology and is now serving as its temporary president. On Monday of this week Professor Thomson celebrated his sixty-seventh birthday.

Limiting Substation Short-Circuits—I

Calculations Are Made to Show the Best Arrangement of Reactances at a Substation Tapping Tie Lines Between Two Generating Plants—Mechanical Forces Acting Upon Bus Supports Are Also Determined

By R. F. GOODING

IN PREVIOUS issues of the ELECTRICAL WORLD[1] two articles have appeared giving in detail the method of calculating short circuits in the generating stations of a large power system. This article will consider in the same way similar problems for the 13,000-volt and 2,300-volt buses in a substation. A comparison is made between the possible short-circuit currents resulting when no reactance is installed at the substation, when bus reactance is used and also when reactance is inserted between tie lines and substation bus. The last arrangement is shown to be most effective in limiting short-circuit effects. This substation will be assumed to be between stations A and B, and to tap the six tie lines between these two stations, as shown in Fig. 1.

Fig. 1 shows a single line diagram of the system under consideration, and substation X is located 30,000 ft. (9 km.) from station A and 20,000 ft. (6 km.) from station B. Each tie line between stations A and B is a 500,000-circ.mil. three-conductor lead-covered cable, having a reactance of 0.0325 ohm per 1,000 ft. (300 m.) Assuming 350 amp. per phase (approximately 8,000 kva.), we find the reactive drop per 1,000 ft. to be 11.375 volts. This gives a reactive drop of 341.25 volts from station A to substation X and of 227.5 volts from B to X. At 13,200 volts the voltage to neutral is approximately 7,600, and the two values just given divided by 7,600 would give 4.48 per cent as reactance of cable from station A to X and 2.98 per cent from B to X. Adding to these values the 2.5 per cent feeder reactance at each generating station, we get 6.98 per cent from A to X, and 5.48 per cent from B to X. These values may be taken as 7 per cent and 5.5 per cent respectively without introducing any appreciable error.

The equivalent power—as derived in the previous articles—on station A bus is 100,000 kva. at 7.55 per cent reactance (7.5 per cent close enough). At station B this figure is 100,000 kva. at 10 per cent reactance. The figure for station A includes the power from station C. Of course, the values for station B are for B operating alone.

The first consideration will be to determine the amount of power developed on the 13,200-volt bus in case of a short circuit with no reactance at the substation, as shown in Fig. 2.

With one tie line operating, station A would deliver to X 100,000 kva. at 95 per cent reactance, obtained as follows:

	Kva.	Per Cent Reactance
Power on station A bus	= 100,000	7.5
One feeder 8,000 kva., 7 per cent reactance	= 100,000	87.5
Power from A to X	= 100,000	95

Similarly, B would deliver 100,000 kva. at 78.75 per cent (say 78.8 per cent) reactance, using 5.5 per cent reactance from B to X and 100,000 kva. and 10 per cent reactance as the power at station B.

[1] ELECTRICAL WORLD, Oct. 18 and Nov. 15, 1919, pp. 827 and 938 respectively.

It should be borne in mind, as stated in the previous articles, that for series circuits the kva.'s in the different circuits must be the same if the reactances are added. This accounts for the values above—one feeder, 8,000 kva., at 7 per cent reactance = 100,000 kva. at 87.5 per cent reactance. In the same way, for parallel circuits, the equivalent reactances must be the same if the kva.'s are added.

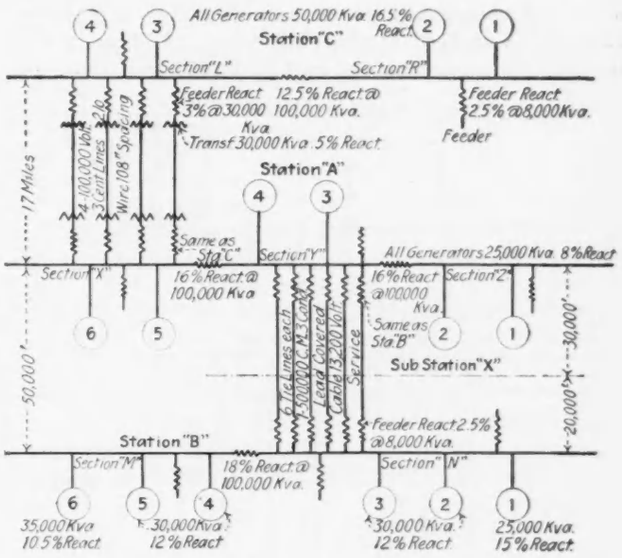


FIG. 1—SINGLE-LINE DIAGRAM SHOWING STATIONS AND CONNECTING LINES

Following the statement just made, it is necessary to reduce the power from station A and station B to its equivalent at the same reactance, and then to add the kva.'s, as follows:

	Kva.	Per Cent Reactance
Power A to X (100,000 kva., 95 per cent reactance)	= 83,000	78.8
Power B to X	= 100,000	78.8
Total power on X bus	= 183,000	78.8
	= 100,000	43

100,000 kva. at 43 per cent reactance gives 232,000 arc kva. = 10,200 amp.

With two tie lines operating, station A would deliver 100,000 kva. at 50 per cent reactance, and station B 100,000 kva. at 43.4 per cent reactance. Then:

	Kva.	Per Cent Reactance
Power A to X (100,000 kva., 50 per cent reactance)	= 82,000	43.4
Power B to X	= 100,000	43.4
Total power on X bus	= 182,000	43.4
	= 100,000	23.8

100,000 kva., at 23.8 per cent reactance gives 420,000 kva. = 18,500 amp. in case of short circuits.

Table I gives values for one to six tie lines operating, with connections as shown on Fig. 2.

It is readily seen that a possible 40,000-amp. short circuit on this bus is too much, so steps should be taken

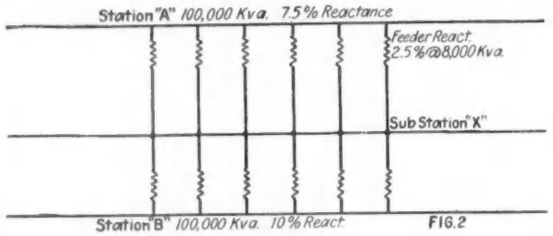
to reduce this value. Probably the cheapest way to do this would be to sectionalize the bus, as shown in Fig. 3.

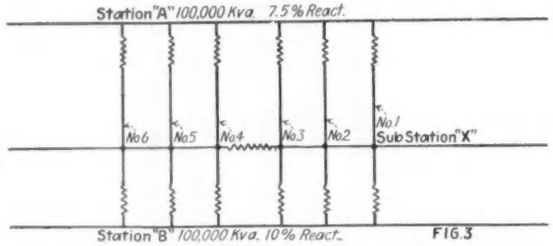
With a bus reactance of 2.5 per cent at 16,000 kva. and lines Nos. 1 and 4 operating, a short circuit—say

TABLE I—NO REACTANCE AT SUBSTATION X

Tie Lines Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short-Circuit Kva.	Short-Circuit, Amp.
1	43.0	232,000	10,200
2	23.8	420,000	18,500
3	17.5	572,000	25,000
4	14.3	700,000	30,700
5	12.2	820,000	36,000
6	11.0	910,000	40,000

on the right-hand section—would be figured thus: Line No. 4 would deliver to the left bus section 100,000 kva. at 43 per cent reactance, as seen in Table I, when no reactance was used at the substation. Adding this to the bus reactance—2.5 per cent at 16,000 kva. (15.6 per





FIGS. 2 AND 3—REDUCTION OF SHORT-CIRCUIT CURRENTS BY BUS REACTANCE

cent reactance at 100,000 kva.)—we get 100,000 kva. at 58.6 per cent reactance as the power from left bus section to right section. Then:

	Kva.	Per Cent Reactance
Power from line No. 4 (100,000 kva., reactance)	= 73,500	43
Power from line No. 1	= 100,000	43
Total power on right bus section	= 173,500	43
	= 100,000	24.8

100,000 kva. at 24.8 per cent reactance gives 404,000 kva. = 17,700 amp. as the short-circuit power on right bus section.

Table II gives results with two to six lines operating.

TABLE II—BUS REACTANCE 2.5 PER CENT AT 16,000 KVA.

Tie Lines Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short-Circuit Kva.	Short-Circuit, Amp.
2	24.8	404,000	17,700
4	14.8	675,000	29,600
6	11.4	880,000	38,600

As this scheme reduces the short-circuit current so little (40,000 amp. to 38,600 amp.), the next step would be to double the bus reactance, making it 5 per cent at 16,000 kva. Table III shows results obtained.

Tables II and III show clearly that a bus reactance will not solve the question. It would not only tend to introduce unequal voltages, unless the same number of tie lines is always on each bus section, but the reduction of short-circuit current from 40,000 amp. to 34,000 amp. is too small to justify the expense of installation. The lines feeding direct to the section in trouble would always deliver their full current into a fault, regardless of what could be added through the bus reactance by the lines on the other bus section. With six lines operating, the three lines next to the fault would supply 25,000 amp., while 9,000 amp. would come from the other three, through the bus reactance, making a total of 34,000 amp. at the fault. The substation bus might be in three sec-

TABLE III—BUS REACTANCE 5 PER CENT AT 16,000 KVA.

Tie Lines Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short-Circuit, Kva.	Short-Circuit, Amp.
2	27.2	368,000	16,100
4	16.6	600,000	26,400
6	12.8	777,000	34,000

TABLE IV—TIE LINE REACTANCE 2.5 PER CENT AT 16,000 KVA.

Tie Lines Operating	Equivalent Reactance at 100,000 Kva. (Per Cent)	Short-Circuit, Kva.	Short-Circuit, Amp.
1	58.6	170,000	7,400
2	31.6	317,000	14,000
3	22.7	440,000	19,300
4	18.2	552,000	24,200
5	15.4	650,000	28,500
6	13.6	735,000	32,300

tions, with two lines per section, but this would make a layout rather too expensive and elaborate for most substations.

REACTANCE BETWEEN TIE LINES AND BUS

The next arrangement to consider would be to locate a reactance between the tie line and the bus, as indicated in Fig. 4. With a 2.5 per cent reactance at 16,000 kva. and only one tie line operating, the equivalent power on the bus will be 100,000 kva. at 58.6 per cent reactance. The one line would deliver to the substation 100,000 kva. at 43 per cent reactance, and this, added to the tie-line reactance of 2.5 per cent at 16,000 kva. (15.6 per cent at

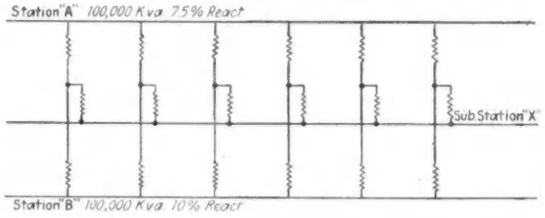


FIG. 4—REACTANCE BETWEEN TIE LINE AND BUS HAS MAXIMUM EFFECT

100,000 kva.) gives 100,000 kva. at 58.6 per cent reactance as the power on the bus. This gives 170,000 kva. for 7,400 amp.

When two lines are used, the power just outside of the reactances would be 100,000 kva. at 23.8 per cent reactance. With the two reactances virtually in parallel, we get 32,000 kva. at 2.5 per cent = 100,000 kva. at 7.8 per cent. By adding this to the power just outside the reactances we get 100,000 kva. at 31.6 per cent reactance as the power on the bus. Values for more than two cables would be calculated in a similar way. Table IV gives results with one to six lines operating.

Table V gives values obtained when using a reactance of 5 per cent at 16,000 kva.

From the results shown in Tables IV and V it is apparent that the reactance does its best work when placed between the tie line and the bus, as just discussed. Subsequent calculations are based on a 5 per cent reactance, giving an equivalent power on the bus of 100,000 kva. at 16.2 per cent reactance.

Although six lines are run into the substation, it is quite probable that the substation load would never require more than four lines. During switching operations all six lines might be on the bus, but this condition would last for only a few minutes at the most. If four was the maximum number of lines on the bus, the short-circuit current would be reduced from 27,000 amp. to 19,600 amp.—a 31 per cent reduction. In view of this reduction in short-circuit current many engineers might prefer to have the structure and breakers capable of withstanding the short-circuit current and stresses from four lines only, considering the possibility of a short circuit during switching operations as too remote to cause any great worry. However, in this article we will consider everything on the basis of preparing against the worst that could possibly happen and will accordingly figure on six tie lines.

Now, with the possibilty of a 27,000-amp. bus short circuit, the question arises, "What is the duty on each individual breaker? Which has the heaviest and which the lightest duty to perform?" To answer the last question first, the breakers having the lightest duty to perform in case of a bus short circuit are the breakers on the tie lines themselves. Each tie line breaker would have to rupture only the current that could be supplied through its own line—something less than 5,800 amp. When only one line is operating it will supply 5,800 amp. to a bus short, but when six lines are on the bus the total is 27,000 amp., or 4,500 amp. per line. If the power on the bus were infinity and six lines were operating, each line would, of course, supply 5,800 amp., the same as when only one line is on the bus.

TABLE V—TIE LINE REACTANCE 5 PER CENT AT 16,000 KVA.

Tie Lines Operating	Equivalent Reactance 100,000 Kva. (Per Cent)	Short-Circuit, Kva.	Short-Circuit, Amp.
1	74.2	135,000	5,900
2	39.4	254,000	11,200
3	27.9	357,000	15,600
4	22.0	453,000	19,600
5	18.5	540,000	23,700
6	16.2	618,000	27,000

In the event of a short circuit on a tie line, its breaker must break all of the current that the five good lines can supply through its own reactance. With five lines on the bus its equivalent reactance at 100,000 kva. would be 18.5 per cent. The tie-line reactance added to this gives 100,000 kva. at 49.7 (say 50) per cent reactance and gives 200,000 kva. or 8,800 amp. as the maximum duty on any tie-line breaker.

In the case of outgoing 13,200-volt feeders, a short on a feeder near the substation would be virtually the same as a bus short with a current of 27,000 amp. to be opened. According to curves published by the American Institute of Electrical Engineers[2] and allowing 0.4 second for the breaker to open, we find that the current at time of opening would be approximately three and three-quarters times normal. This gives 375,000 kva. = 16,500 amp. as the actual duty on a feeder breaker rupturing close to the bus.

This shows what at first sight seems an impossible condition—that a breaker 30,000 ft. and 20,000 ft. (9 km. and 6 km.) respectively from the two power stations must rupture 50 per cent more current than a feeder breaker located directly on the buses of the power stations. However, in the first article on this subject it was found that the short-circuit current on a radial feeder was not more than 11,700 amp., and this is the *initial* value, with no allowance made for its decrease by the time the breaker opens. It is well to bear this condition in mind when considering breakers for such a system as this, because a breaker that is satisfactory for use on the power-station feeders may be entirely unfit for use on substation feeders. In fact, this will usually be the case when the substation is fed from tie lines between power stations or has several parallel feeders from one power station.

CALCULATION OF MECHANICAL STRESS AT BUS SUPPORTS

Having determined the duty on the 13,200-volt breakers, the next problem is to determine the amount of stress on the bus supports. For these calculations it is best to proceed on the basis of unsymmetrical short circuits, although for breaker applications all shorts are assumed to be symmetrical. When a short circuit is asymmetrical, or unsymmetrical, its value may be one and three-quarters times to twice that of the symmetrical short. To be on the safe side then it is best to design the bus structure on the basis of an entirely unsymmetrical short circuit, with the initial value twice that of the symmetrical short. This means that 54,000 amp. should be the current used for this calculation.

The force per foot between buses is figured from the formula[3]

$$F_2 = (I^2_2 \times 8.08 \times 10^{-7})/S,$$

where I_2 = three-phase short-circuit current and S = distance between centers of buses in inches. Assume $S = 18$ in.; then:

$$\text{Force} = (54{,}000^2 \times 8.08 \times 10^{-7})\ 18 = 142.5 \text{ lb. per foot.}$$

With bus supports 4 ft. (1.2 m.) apart, this gives 570 lb. (258.5 kg.) as the force on each support.

The consideration of short circuits on the low-tension bus and substation feeders will be taken up in an early issue.

[2] *Transactions*, A. I. E. E., 1918, p. 123.
[3] Leonard and Riker, *Electrical Journal*, December, 1917.

Coke Breeze and Anthracite Screenings Burned at 200 Per Cent Rating

COKE breeze and anthracite screenings have been burned on a coke traveling grate stoker under a flat-arch furnace by the Rochester (N. Y.) Gas & Electric Corporation with very satisfactory results. It was found that 125 per cent to 200 per cent of the normal boiler load could be maintained so long as fuel of this kind was uniform in size and well mixed and contained not more than 10 per cent to 15 per cent of moisture. For best results the furnace should have a flat arch. A draft of 1 in. to 1¼ in. (2.5 cm. to 6.3 cm.) is required for a 4½-in. (11.1-cm.) fuel bed. In burning this fuel some trouble was experienced with clinkers adhering to the firebrick walls, but this might be overcome by running the carborundum bricks used for lower courses higher.

I. E. POWELL.

Rochester, N. Y.

Magnetic Properties of Iron-Nickel Alloys

In Strong Fields Alloys Low in Nickel Content Show High Saturation and Permeability, but Also High Hysteresis Loss—At About 50 per Cent Nickel the Alloys Give Excellent Characteristics

By T. D. YENSEN

Research Laboratory, Westinghouse Electric & Manufacturing Company, East Pittsburgh

THIS investigation was undertaken to determine whether any iron-nickel alloys could be found having a higher saturation value than pure iron. Alloys were prepared containing 0-100 per cent nickel. Pure Fe-Ni alloys do not forge readily, and to make them forgeable it is necessary to add alloying elements like manganese or titanium. The results show that the saturation value decreases slowly with increase in nickel content up to 20 per cent Ni, then rapidly to 30 per cent, again rises rapidly to 50 per cent, and falls off gradually toward 100 per cent Ni. At no point does it exceed that of pure iron. For values of H between 100 and 400 the permeability is about 5 per cent higher for 6 to 8 per cent Ni than for pure iron, but this advantage is offset by the large increase in hysteresis loss. Alloys containing 35 to 70 per cent Ni have high permeability at low and medium densities and low hysteresis loss, the highest permeability occurring for 50 per cent. Thirty to 50 per cent alloys are characterized by a nearly straight line B-H curve from the origin to $B = 2{,}000$ to 4,000 gauss, and also by low retentivity and coercive force, properties which are of value in connection with certain electromagnetic meters.

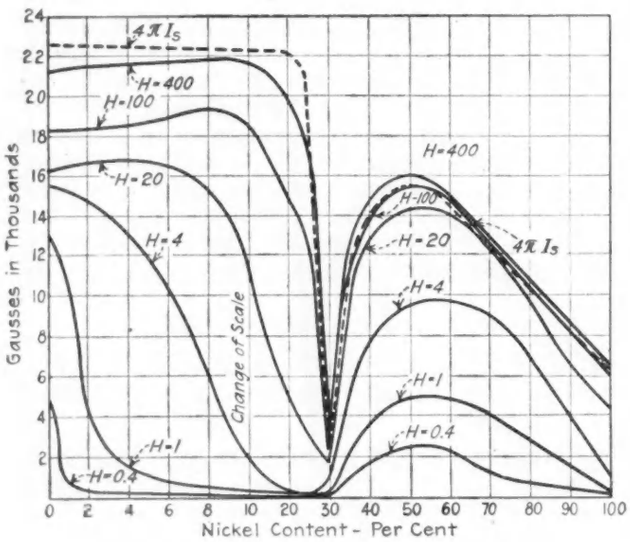


FIG. 1—SATURATION INTENSITY AND ISO-GILBERT CHARACTERISTICS

Previous investigations on commercial iron-nickel alloys have shown that 25 to 35 per cent alloys have irreversible magnetic and electrical transformation points occurring below ordinary temperatures. The present investigation confirms these results for pure alloys. It is pointed out that the irreversible transformation causes an enormous increase in the hysteresis loss.

Importance of High Magnetic Saturation

The discovery of materials having higher magnetic saturation than pure iron is of great importance in connection with dynamo-electric machinery, because it is the saturation value of the material in the teeth of the armature that determines to a large extent the size of the machines. If the saturation value could be raised 10 per cent, this would mean that the length of the armature—and consequently the field and frame—could be decreased by approximately 10 per cent, with a resultant large saving in the cost of the machine. Cobalt has been known for some time to increase the saturation value, in the case of the alloy Fe_2Co by as much as 10 to 13 per cent.[1] At high inductions the author[2] has shown that the permeability of Fe_2Co may be as much as 25 per cent higher than that of pure iron. This alloy would therefore seem to be very suitable for the purpose mentioned were it not for its high cost. Efforts have consequently been made to discover less expensive materials with properties similar to those of Fe_2Co.

Nickel has been suggested as a possible substitute for Co, although according to Weiss,[3] nickel lowers the saturation value of iron. Burgess and Aston[4] prepared a large number of alloys ranging from 0-100 per cent Ni, and among these there were one or two alloys having a slightly higher permeability at high inductions than pure iron. The composition of these alloys was in the neighborhood of 5 per cent Ni. These results and certain others obtained with low-nickel steels prepared commercially made it desirable to investigate carefully the possibilities in the direction indicated. Alloys were consequently prepared from the purest materials obtainable and by the most approved method known to yield pure alloys.

The alloys were made by melting the desired proportions of electrolytic iron and electrolytic nickel placed in magnesia crucibles in an Arsem type vacuum furnace under pressure of 1 mm. to 2 mm. Hg.

The first attempts that were made to forge the ingots revealed the fact that pure iron-nickel alloys do not forge very well at ordinary forging temperatures. Up to 8 per cent Ni, and in rare cases with higher nickel contents, fairly good forgings were obtained by forging at a dull red heat, but not by forging at a bright red heat. In other cases the alloys would forge at a black heat, or even cold, while some alloys could not be forged under any conditions. In order to obtain pure iron-nickel alloys in the form of test pieces it was, therefore, necessary in some cases to machine rings directly from the ingots. Forgeable alloys were obtained by means of certain addition agents. Titanium and manga-

[1] Weiss, "Electromagnet with Ferro-cobalt Pole Pieces," *Comptes Rendus*, 156, p. 1970, June 30, 1913; *Trans. Faraday Soc.*, 8, p. 149, 1911-12. Yensen, "Magnetic Properties of the Iron-cobalt Alloy Fe_2Co," *Gen. Elec. Rev.*, 18, p. 881, September, 1915; *Proc. A. I. E. E.*, 34, p. 2463. Kalmus and Blake, "Magnetic Properties of Cobalt and Iron-cobalt Alloys," Canadian Department of Mines, Mines Branch, Report 413, 1916. Becket, "Alloys of Iron and Cobalt," U. S. Patent 1,247,206, November, 1917.

[2] *Loc. cit.*

[3] *Loc. cit.*

[4] "Magnetic and Electrical Properties of Iron-nickel Alloys," *Met. and Chem. Engr.*, 8, p. 23, January, 1910.

nese worked successfully for this purpose, while Si, Al and magnesium had no effect. The amounts of Ti and Mn required varied from 0.2 per cent for 10 per cent Ni to 1.0 per cent for 50 per cent.[5]

The annealing was done at 900-950 deg. C., in rare cases at higher temperatures, in a vacuum furnace, under a pressure of 0.1 mm. Hg., the test pieces being buried in granulated MgO and the temperature measured by means of a platinum-platinum-rhodium thermocouple. The cooling was extended over a period of twenty-four hours and was done at a rate of approximately 30 deg. per hour.

The magnetic testing of the rods was done by the Burrows compensated double bar and yoke method, this being the most approved method thus far developed for rods. The rings were tested by means of the ordinary two-winding method, no other method being either simpler or more accurate.

Discussion of Saturation and Permeability

The curves for H = 0.4, 1, 4, 20, 100, 400, and for the saturation intensity, 4 πIs, have all been plotted in Fig. 1, showing at a glance the variation in permeability for various magnetizing forces with variation in nickel content. These curves might be termed the magnetic iso-gilberts for the iron-nickel alloys. To this set of curves the following general statements can be applied:

1. The saturation intensity, I_s, decreases slightly—not more than 1 or 2 per cent—from pure iron to 20 per cent nickel. Between 20 and 30 per cent nickel I_s decreases to one-tenth of its previous value, increases again rapidly beyond 30 per cent, reaches a maximum for 50 per cent nickel, and finally decreases gradually toward 100 per cent, the value for pure nickel being between one-third and one-fourth that for pure iron.

2. The iso-gilberts for high values of H are of the same general shape as that for I_s, except that there is a slight increase—about 5 per cent—in permeability between 0 and 8 per cent nickel.

3. For low values of H the iso-gilberts drop rapidly from pure iron and remain very low until the 30 per cent point has been passed, reaching a maximum between 50 and 60 per cent nickel, for which in some cases a permeability has been reached approaching that for pure iron, and finally decreasing to very low values for 100 per cent nickel.

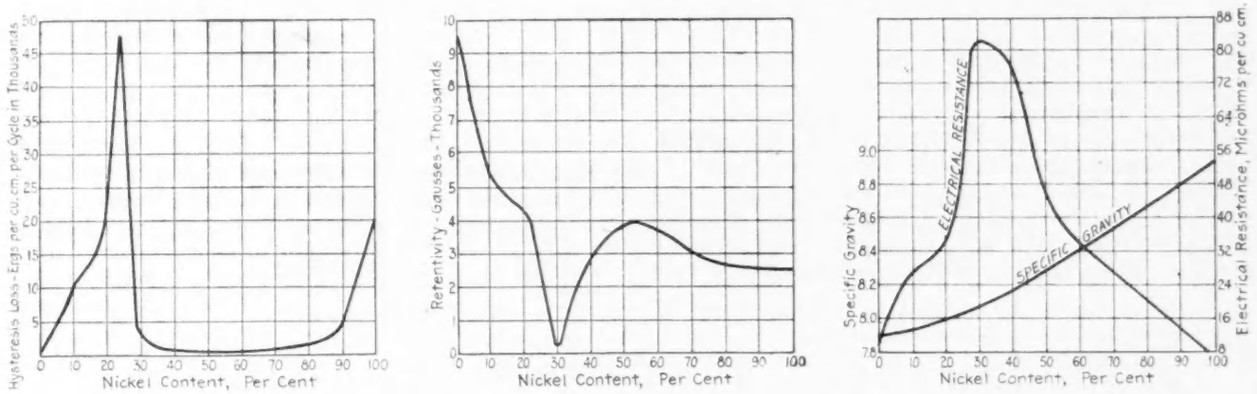
[5]The problem of forgeability of the iron-nickel alloys is dealt with in a paper presented at the New York meeting of the A. I. M. E., February, 1920.

Fig. 2 shows the variation of hysteresis loss for B = 10,000 gausses with nickel content. As might be expected from the iso-gilberts of Fig. 1, the loss increases rapidly even with small additions of nickel, and the loss becomes very high for alloys containing 15 to 25 per cent, reaching a maximum of nearly 50,000 ergs per cc. per cycle for the 25 per cent alloy. Between 30 and 70 per cent the loss is as low as or even lower than for pure iron, but above 70 per cent the loss again increases rapidly, reaching 20,000 for pure nickel.[6]

Fig. 3 shows the retentivity to decrease with increasing nickel content, reaching a minimum of only 200 for the 30 per cent alloy. With further increase in nickel content the retentivity again increases, reaching a maximum between 50 and 60 per cent nickel.

Fig. 4 shows the variation in electrical resistance, checking very closely the results obtained by Burgess[7] and by Honda.[8] The curve has been drawn through the points for pure iron-nickel alloys for all cases in which alloys were available in the form of rods. In every case the alloys containing a small amount of silicon have a decidedly higher resistance than the alloys without silicon, as might be expected. The curve reaches a maximum for 30 per cent nickel, corresponding to the composition of the alloy having the lowest magnetic saturation value.

The specific gravity shown in Fig. 4 was obtained incidentally as a means of obtaining the true cross-section of the ring test pieces. The values increase uniformly from 7.9 per cent for pure iron to 8.9 for pure nickel.



FIGS. 2, 3 AND 4—VARIATION OF PROPERTIES OF NICKEL ALLOYS WITH PERCENTAGES OF NICKEL FROM 0 TO 100
(2) Hysteresis loss, (3) retentivity, (4) electrical resistance and specific gravity.

An Iron-Nickel Compound May Exist at About 30 Per Cent Nickel

The results thus far given would seem to indicate that an iron-nickel compound exists corresponding to about 30 per cent nickel, because both the magnetic and electrical properties change very abruptly for this composition. However, these results are misleading in this

[6]All losses are based on a flux density of 10,000 gausses. In case of the 30 and 80-100 per cent alloys having saturation values lower than 10,000, the losses were obtained for as high densities as possible, and the hypothetical loss for 10,000 calculated by means of the formula:

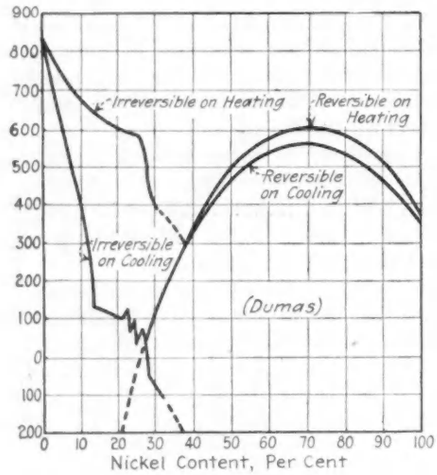
$$W_{10} = W_B \times \left\{\frac{10000}{B}\right\}^{1.6}$$

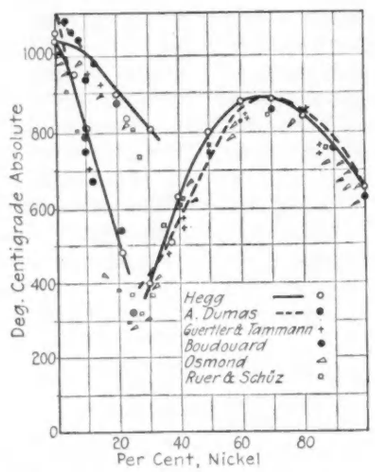
where W_B is the loss actually obtained by test for the flux density B. The 1.6 law may not be strictly applicable in the case of the alloys mentioned but is believed to be sufficiently accurate for the purpose of comparison.

[7]*Loc. cit.*

[8]"The Thermal and Electrical Properties of Nickel Steels," *Scientific Reports Tohoku Imp. Univ.*, 7, pp. 59-66, 1918.

respect. It has been shown that the properties of the alloys in the neighborhood of 30 per cent nickel are very different after being cooled to liquid air temperature from what they are after being cooled merely to room temperature, and furthermore that this difference is due to the fact that these alloys—in addition to the reversible magnetic transformation points occurring above room temperature—have irreversible transformation points occurring below room temperature.[9]

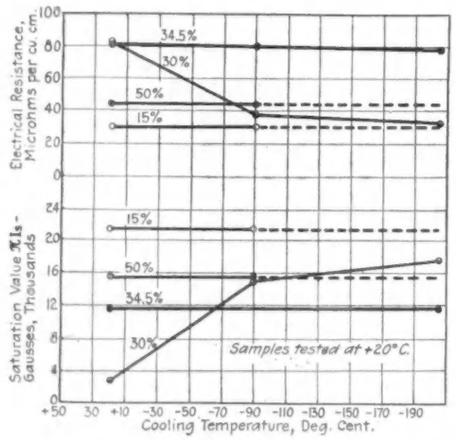


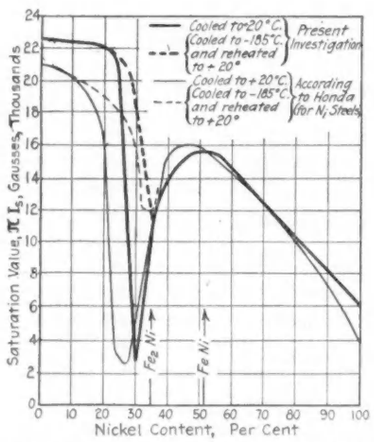


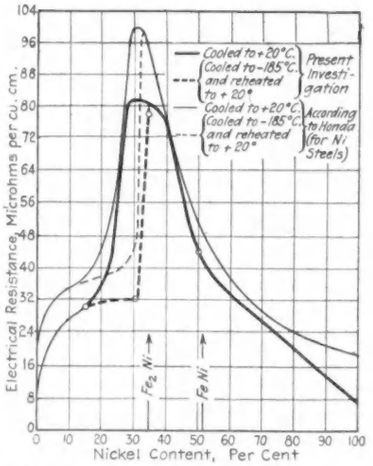
FIGS. 5 AND 6—RESULTS OBTAINED BY MANY INVESTIGATORS OF REVERSIBLE AND IRREVERSIBLE TRANSFORMATIONS

Fig. 5 gives results of Dumas, for alloys without *C* and Mn

These transformations have been studied a great deal in recent years, the pioneers in the field being Hopkinson[10], LeChatelier[11], Osmond[12], Guillaume[13] and Dumas[14]. The alloys investigated by these scientists all contained foreign elements to some extent, particularly carbon and manganese. As a matter of fact manganese was considered an essential constituent, because without it the alloys could not be forged. It is very unfortunate, however, for the interpretation of the results of the above investigations that these two elements referred to are the ones that affect the transformation points the most. Thus carbon is twenty times as effective as nickel in lowering the transformation points, and manganese, while less effective in this respect than in carbon, still is much more effective than nickel. Dumas[15] realized this when he stated that "No nickel steel is non-magnetic at ordinary temperatures except steels containing carbon and manganese," and he consequently attempted to keep these elements as low as possible. The results of his experiments are shown in Fig. 5. It will be noted that in the region of 27 to 31 per cent nickel Dumas found both reversible and irreversible transformations. Of the two, however, the irreversible was by far the more intense. The broken curves indicate probable transformations in pure alloys that are too feeble in comparison with the transformations that have already occurred to be readily detected. However, by introducing carbon into the alloys the irreversible transformation points may be lowered sufficiently without lowering the reversible points, to reveal the latter. Dumas cites the example of a 23 per cent alloy, which when pure has an irreversible point on cooling at + 75 deg., but apparently no reversible point. By adding 0.85 per cent *C* and 1.41 per cent Mn to this alloy the irreversible point is decreased to —188 deg., and on cooling from 0 deg. — the alloy is now non-magnetic—the reversible point is revealed at —150 deg. On the assumption that the reversible points are unaffected by *C* or Mn, Dumas concludes that the pure Fe-Ni alloys between 20 and 37 per cent nickel have both reversible and irreversible transformation points.






Electrical Resistance, Microhms per cu. cm.
Cooled to +20°C.
Cooled to -185°C. and reheated to +20°
Present Investigation
According to Honda (for Ni Steels)
Fe2 Ni
Fe Ni
Nickel Content, Per Cent

FIGS. 7, 8 AND 9—COMPARISON OF RESULTS OBTAINED BY AUTHOR AND BY HONDA IN STUDY OF REVERSIBLE AND IRREVERSIBLE TRANSFORMATIONS

In a recently published circular[16] the Bureau of Standards has compiled all the important data published prior to 1916 relating to iron-nickel alloys and includes an extensive bibliography. Fig. 6 gives the magnetic trans-

[9]The magnetic transformation point is the temperature at which the alloy loses a part or all of its magnetizability on heating and the temperature at which it regains a part or all of the magnetizability on cooling. If these two temperatures coincide, the transformation point is reversible, otherwise it is irreversible.

[10]*Proc. Royal Soc.*, 46 and 47, p. 23, 1889; 48, p. 1, 1890.

[11]*Comptes Rendus*, 90, p. 285, 1890.

[12]*Comptes Rendus*, 118, p. 532, 1894; 121, p. 648, 1895; 128, pp. 306, 1395, 1513, 1899.

[13]*Comptes Rendus*, Jan. 25, April 5, June 18, July 26, 1897.

[14]*Comptes Rendus*, 139, p. 42, 1899; *Jour. Iron and Steel Inst.*, 11, p. 225.

[15]*Loc. cit.*

[16]Circular No. 58, "Invar and Related Nickel Steels," April 4, 1916.

formations according to Hegg reproduced from this circular, giving also points determined by Dumas and by Osmond magnetically, by Guertler and Tammann and by Rurer and Schuz metallographically, and by Boudouard thermo-electrically. The ordinates of this curve are in absolute degrees centigrade (= 273 + deg. C.).

More recently Honda[11] has studied the magnetic and electrical properties of nickel steels at ordinary temperatures and after quenching in liquid air. The latter treatment caused remarkable changes in the region of 25 to 30 per cent nickel, but no appreciable changes for other nickel contents, thus confirming the results already referred to. The results are shown in Figs. 8 and 9. On account of the foreign elements present in Honda's steels it seemed desirable to repeat his tests with pure alloys and thus round out the investigation of the iron-nickel alloys by the writer.

The samples used were selected from those used in the previous investigation, the preparation of which is fully described in the first part of the paper. The test pieces used are as follows:

Two Ni (225)—15 per cent Ni, two rods.
Two Ni (232)—30 per cent Ni, two rods and one ring.
Two Ni (233)—34.5 per cent Ni, one rod and one ring.
Two Ni (234)—34.5 per cent Ni, one rod and one ring.
Two Ni (261)—50 per cent Ni, one rod.
Two Ni (262)—50 per cent Ni, one rod.

As a preliminary the rings were tested successively at room temperature, in CO_2 snow (—80 deg. C.), again at room temperature, then in liquid air (—180 deg. C.) and finally at room temperature. Then the rods were tested at room temperature, after having been cooled to —80 deg. and after having been cooled to —180 deg. The cooling to —80 deg. was done by immersing the test pieces in gasoline, gradually adding CO_2 snow until no more would melt and maintaining the temperature for about half an hour by adding more snow from time to time.

Remarkable Effect of Cooling Temperature on 30 Per Cent Alloy

The results are shown graphically in Figs. 7, 8 and 9. It will be noted that while there is practically no change in the properties of the 15, 34.5 and 50 per cent alloys, the 30 per cent alloy has undergone a marked change. Its saturation value was increased from 2,700 to 14,600 by cooling to —80 deg. and to 17,800 by cooling to —180 deg. Similarly, the electrical resistance was decreased from 82 to 38 and to 32 by the above treatments. It is probable that the change would have gone to completion at —80 deg. if the test piece had been held there sufficiently long and that the irreversible transformation point therefore lies betwen 0 deg. and —80 deg., thus confirming Dumas' results.

While only a few points were determined, they are sufficient to demonstrate that the cusp of both curves, after the completion of the transformations, occurs for approximately 34.5 per cent nickel instead of for 30 per cent, as the previous investigation would lead one to believe. This points strongly toward the existence of the compound Fe_2Ni, corresponding to 34.6 per cent nickel, suggested by earlier investigators. The existence of the compound FeNi, corresponding to 51.5 per cent nickel, is more doubtful, because there is no definite indication of it in the electrical resistance curve.

It is interesting to note that while the saturation value of the 30 per cent alloy was increased to a remarkable extent by being cooled to below the irreversible transformation point, the permeability at low flux densities was decreased and the hysteresis loss enormously increased, the latter fifteen times. In other words, the reversible transformation produces a material with low hysteresis loss and low magnetic saturation, while the irreversible transformation produces a material with six times the saturation value but with fifteen times the hysteresis loss.

It is also interesting to note that there apparently is no change in the microstructure of the 30 per cent alloy accompanying the marked magnetic and electrical transformation. It is therefore apparent that the magnetic and electrical transformations are atomic or ionic in their nature.

[11] "The Thermal and Electrical Properties of Nickel Steels," *Scientific Reports*, Tohoku Imp. Univ., 7, p. 59, 1918.

Economical Division of Load on Several Lines

Based on Maintaining Equal IR Drops—Where Not Considered, Annual Energy Losses Are Sometimes Twice Annual Investment Charge

By Lansing W. Thoms

IN CENTRAL-STATION practice a condition often arises wherein a load at a particular point is so large that it has to be served by several lines. Sometimes it is possible by proper arrangement of that load to obtain any desirable division of it over the several lines. A common instance of this is the single customer who requires several lines for his service. In such a case some arrangement may be made with him for proper division of his load at his bus. By this method an apportionment of the load can be made whereby the maximum economy of operation can be obtained. In the following article a determination of the most economical division of load over several lines is made and an illustration of actual conditions is given.

Since the investment charges on the installation are constant, the only variable cost in handling the load is the cost of the energy losses. Therefore the minimum total cost, and hence maximum economy, is obtained in the case where there is a minimum cost of energy losses.

It is at once evident that if the several lines are of the same size wire, spacing and length the most economical operation would be obtained when the load is equally divided. However, in most cases the lines will not be of the same length or wire size, and there will be differences in the size and length of cable and wire used; hence the resistance will be different. Since the energy losses vary as the resistance and the square of the current, it can be seen that the total energy losses with a given load will vary as the load is divided among several lines. There is then a certain division of the load with which the total energy losses are a minimum.

Annual Energy Loss Sometimes Double Investment Charge

The cost of the energy losses can be calculated with a fair degree of accuracy. With a heavy load it is possible, and indeed not rare, to find the annual cost of these energy losses equal to and even twice as much as the annual investment charge on the installation. It can be seen, then, that with an appreciable load at an appreciable distance the cost of transmission will depend upon the load division between the several lines.

The mathematical solution is as follows:

Nomenclature:

Y_t = total annual cost of line, including investment charge, taxes, depreciation and cost of energy loss.

Y_{tt} = total annual cost of all lines, including investment charge, taxes, depreciation and cost of energy loss.

Y_i = annual charge on investment of line, including investment charge, taxes and depreciation.

Y_{it} = total charge on investment of all lines, including investment, charge, taxes and depreciation.

Y_e = annual cost of energy losses in line.

Y_{et} = total annual cost of energy losses in all lines.

I = current per line in amperes.

I_t = total current in all lines in amperes.

I_{ec} = economical current per line in amperes.

k = constant.

R = total equivalent resistance of line.

Considering two lines, let one line be designated by prime (′) and the other by double prime (″). Then:

$$Y_{tt} = Y'_t + Y''_t$$
$$Y_t = Y_i + Y_e$$
$$Y_e = kI^2$$
$$Y_{tt} = Y'_i + Y''_i + k'I'^2 + k''I''^2$$
$$I' + I'' = I_t$$
$$I' = I_t - I''$$
$$I'^2 = I_t^2 - 2I_t I'' + I''^2.$$

Then:

$$Y_{tt} = Y'_i + Y''_i + k' (I_t^2 - 2I_t I'' + I''^2) + k'' I''^2.$$

With a given installation the investment charge is a constant; then the total annual cost of the installation is a minimum when the energy losses are a minimum.

Hence Y_{tt} is a minimum when Y_{et} is a minimum.

Since:

$$Y_{et} = k' (I_t^2 - 2I_t I'' + I''^2) + k'' I''^2 \qquad (1)$$

$$\frac{Y_{et}}{I_t} = k' \left(I_t - 2 I'' + \frac{I''^2}{I_t}\right) + k'' \frac{I''^2}{I_t}$$

Then the minimum operating charge is obtained when Y_{et}/I_t, or the annual cost of energy loss per ampere transmitted, is a minimum. This occurs when

$$\frac{d\,(Y_{et}/I_t)}{d\,I''} = 0$$
$$= -2k' + 2k'I''_{ec}/I_t + 2k''I''_{ec}/I_t$$

or

$$I''_{ec} = I_t \frac{k'}{k' + k''}$$

and

$$I'_{ec} = I_t \frac{k''}{k' + k''}$$

and

$$I''_{ec}/I'_{ec} = k'/k''.$$

Since k is proportional to R:

$$I''_{ec}/I'_{ec} = R'/R''$$

or

$$I''_{ec}R'' = I'_{ec}R'$$

In the case of more than two lines, two lines can be considered as one by use of an equivalent circuit and the mathematical development carried as above.

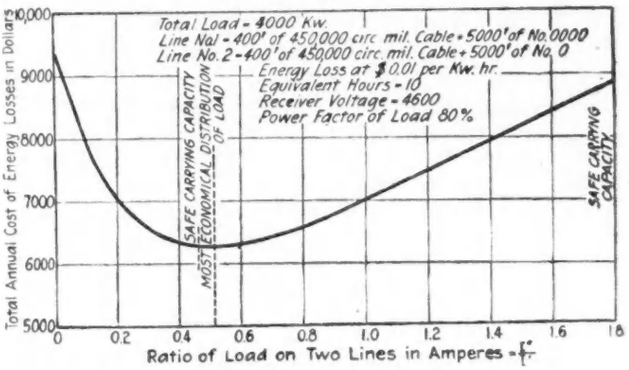
Then:

$$I'_{ec}R' = I''_{ec}R'' = I'''_{ec}R''' = I^{IV}_{ec}R^{IV}, \text{ etc.};$$

i.e., the most economical division of load over several lines is effected when the IR drops over several lines are equal. From this a chart can be made up for any combination of lines giving the most economical currents for any total load. Arrangements can then be made to divide the load so that each line carries a load as near as possible to the most economical.

IR Drop Should Determine Local Division

It should be noted that with lines of different characteristics there will be differences in the power factor of the several lines. Hence the ratio between amperes and kilowatt load will be different for each line. The most economical division of the load, however, is attained when the IR drops over the several lines are equal. The load then should not be divided according to the kilowatts but with reference to the IR drops in the lines.



TOTAL ANNUAL COST OF ENERGY LOSSES FOR VARIOUS METHODS OF DIVIDING LOAD BETWEEN TWO LINES

In order to show the effect in annual costs of different divisions of load a particular case is considered as follows:

Number of lines	= two.
Total load	= 4,000 kw.
Power factor	= 80 per cent.
Receiver voltage	= 4,600 volts.
First line	— 400 ft. (122 m.) of 450,000-circ. mil. cable and 5,000 ft. (1,524 m.) of No. 4/O overhead.
Second line	— 400 ft. (122 m.) of 450,000-circ. mil. cable and 5,000 ft. (1,524 m.) of No. O overhead.
Cost of energy loss	= $0.01 per kilowatt-hour.
Equivalent hours	= 10.

The total annual costs of the energy losses (Y_{et}), computed by equation (1), are shown as a curve in the accompanying illustration as a function of I''/I'. It can be seen that as the proportions of the total load carried by each line varies the annual costs also vary. In this case the annual cost of energy losses runs from $6,200 at the most economical point of operation to $8,750 at the maximum cost of operation. The maximum variation in the annual cost of the installation is $2,550, depending upon whether it is economically operated or not.

The division of the load is limited by the allowable current capacity of each line as shown on the curve. From the value of $I''/I' = 0.45$ to about $I''/I' = 0.65$ the actual difference in annual cost is not large. Beyond this point the curve rises more rapidly. The point of minimum cost comes at $I''/I' = 0.51$, which, as might be anticipated from the foregoing theoretical discussion, is the point where $I'R'' = I''R''$

$$R' = 0.2643 \qquad R'' = 0.5198$$
$$R'/R'' = 0.2643/0.5198 = 0.51 = I''/I'$$

High-Voltage Service Entries*

St. Louis Practice Covering Methods of Protection and Installation—Types of Equipment Specified for Indoor Customers' Substations Designed for 13,200-Volt Primary Metered Service

By WALTER H. MILLAN

Superintendent of Substations Union Electric Light & Power Company, St. Louis

THE problem of working out a safe layout for primary substations is comparatively simple when the entire establishment is a new one and the building is of good fireproof construction. However, a large number of installations are needed in old buildings where some intensive manufacturing process requires a very much larger amount of power than was originally intended to be fed into the building. An explanation of the method of handling such layouts in St. Louis will be given here.

The first obstacle to be overcome is generally to secure the assignment of adequate space for the installation of the equipment. Some 400 sq.ft. to 600 sq.ft. (40 sq.m. to 60 sq.m.), with 14 ft. (4.2 m.) head room, in a clean part of the building, should be allotted for substations rated at from 150-kw. to 1,500-kw., 13,200 volts, 25-cycle or 60-cycle.

Another consideration in the layout of the substation equipment is safety with respect both to those who must operate and maintain the equipment and to fire fighters who may be called upon to enter the main building. Next should be considered the provision of ready access to equipment to facilitate cleaning and repairing it. The average installation consists of a bank of single-phase transformers or of a single three-phase transformer for supplying 230-volt or 460-volt power circuits and a separate single-phase transformer for supplying 115/230-volt lighting circuits. Outdoor-type transformers are always specified on account of the possibility of interchanging with units in outdoor substations.

Each transformer bank is protected by a 300-amp., 15,000-volt, triple-pole, single-throw automatic oil switch mounted in a brick or concrete cell which effectively isolates it. A very rugged switch is used with an instantaneous rupturing capacity of 4,000 amp. at a sustained voltage of 13,000 (A. I. E. E. rating). The switch is operated by means of hand lever mounted on a panel remote from the switch cell, the panel being so located as to permit the operator to reach the substation exit without passing any of the equipment. This arrangement practically eliminates the likelihood of personal injury should a switch failure occur.

The lighting transformers are protected by fusible disconnecting switches. The circuits to the power transformers are usually provided with disconnecting switches so that these transformers may be disconnected when not in use without cutting off the building lights. An attempt is made to arrange the equipment in such a manner that passageways at least 4 ft. (1.2 m.) in width will be provided.

All live exposed high-tension conductors and terminals as far as possible are kept at least 8 ft. (2.5 m.) above the floor line. This usually necessitates 14-ft. (4.3-m.) head room. Where the exposed live parts must be placed lower they are protected by screens 8 ft. (2.5 m.) in height.

*Presented before the recent annual meeting of the Western Association of Electrical Inspectors.

At the present time it is the practice to feed all such customer installations through underground entrances even though the supply feeder is an overhead line. In this case a three-conductor cable is brought down a conveniently placed pole and through an underground conduit to a pothead in the consumer's substation. Near each pothead is a set of disconnecting switches feeding a primary bus. This in turn feeds (1) the power transformers through disconnecting switches and an oil switch, and (2) the lighting transformers through fusable disconnecting switches which are so mounted that the fuses are dead when the switch blades are open.

GENERAL SPECIFICATIONS FOR 13,200-VOLT CUSTOMERS' SUBSTATION EQUIPMENT

DISCONNECTING SWITCHES:

Six 300-amp., 15,000-volt disconnecting switches mounted on steel base and equipped with safety latches.

LIGHTNING ARRESTER:

One 13,200-volt indoor-type oxide-film or electrolytic lightning arrester suitable for operation on three-phase ungrounded neutral cycle system.

Three 50-amp., 15,000-volt combined disconnecting switches and carbon-tetrachloride fuse holders mounted on steel bases. Six 25-amp. fuses should be provided, three of which are for emergency purposes.

CHOKE COILS:

Three 200-amp., 15,000-volt indoor-type choke coils mounted on steel bases.

OIL CIRCUIT BREAKER:

One 300-amp., 15,000-volt triple-pole, single-throw, hand operated remote-controlled automatic oil circuit-breaker with two-coil transformer-trip and including two 15,000-volt current transformers. This oil circuit-breaker should have a rupturing capacity of 4,000 amp. at 13,200 volts, three-phase (A.I.E.E. rating) and should consist of three separate single-pole elements operated by common mechanism and arranged for mounting in masonry cell.

The necessary cell material consisting of slate, soapstone, doors, structural steel work and fittings for cell must also be provided.

POWER TRANSFORMERS:

....Kva., ...phase, ... cycle, oil insulated, self-cooled, out-door type, transformers; primary voltage, 13,200 volts with four 2½ per cent taps below; Scondary, 230-460 volts.

LIGHTING TRANSFORMERS:

....Kva., single-phase, ...cycle, oil-insulated, self-cooled outdoor type transformer; primary voltage, 13,200 with two 5 per cent taps below; secondary, 115-230 volts.

....amp., 15,000-volt carbon-tetrachloride fuse holders mounted on steel base. .... amp fuses. Four fuses should be provided for each transformer, half the number being for emergency purposes.

SWITCHBOARD PANEL:

One 62-in. by 20-in. by 2-in. (158-cm. by 51-cm. by 51-mm.) slate panel with 28-in. by 20-in. by 2-in. (71-cm. by 51-cm. by 51-mm.) sub-base mounted on pipe framework. The switchboard to have mounted thereon:

One 175-volt alternating-current voltmeter with 21,000-volt scale. Two single-pole inverse-time-limit circuit-opening overload relays.

Operating lever for oil circuit breaker.

One eight-point potential receptacle with four-point plug and holder.

Space and drilling for one G. E. Co. type DS-6 watt-hour meter and one G. E. Co. type G-4 demand meter, both of which will be furnished by the power company.

If the supply originates in an overhead line, the substation is protected by an electrolytic or "oxide-film" lightning arrester installed as near the pothead of the incoming cable as possible. The arrester is protected and controlled by fusable disconnecting switches in each phase. These "disconnects" are fed from the pothead side of the main disconnecting switches, making the arrester independent of the rest of the equipment and effective even though the main disconnecting switches are open. Where an arrester is used choke coils are connected in the main circuit on the load side of the main disconnecting switches.

Where practicable the main wiring consists of No.

1/0 (53.5-sq.mm.) solid copper, insulated with ⅜-in. (9.5-mm.) varnished cambric and the whole covered with a single white flame-proof braid. This wire is carried on standard busbar supports, the porcelains of which have a rating of 22,000 volts. When sufficient head room is available these supports are mounted on ½-in. (32-mm.) pipe framework supported from the floor. All of the wiring and equipment are mounted independently of the walls and ceiling of the room when possible. Insulators, disconnecting switches, current and potential transformers, choke coils, etc., so far as possible are incorporated in the 1¼-in. (32-mm.) pipe structure, which is carried down to the floor. The various members of this framework are joined by clamp-type fittings to avoid threading and bending. The center-to-center spacing of all 13,000-volt wiring is kept at 30 in. (75 cm.) or more, except where the circuits must be brought closer together to permit entering the oil-switch coil. At this point, however, there are no exposed live parts. Where possible the spacing is increased to 36 in. (90 cm.) between wires.

Ventilation is afforded by means of louvres (roof ventilators) and screened windows, admitting air directly from the outside of the building.

Particular attention is paid to the grounding of the frames and bases of all equipment. This is accomplished by means of driven pipes. Independent grounds are provided for the lightning arrester, the cases of the power and lighting transformers, the instrument wiring and the pipe framework. The bases of all disconnecting switches, choke coils, current transformers, etc., are grounded to the iron framework. Conductors connecting the various bases, framework, etc., to the ground pipes are No. 1/0 (53.5 sq.mm.) solid bare-copper wire. This connection is larger in cross-section than the line feeding the installation and will not burn off under the most severe conditions.

In general the wiring from the secondary side of the transformers is placed in conduits buried in the floor, which arrangement usually facilitates the removal of any of the high-voltage equipment and increases the safety of the installation.

Third Harmonics in Three-Phase Systems

Calculation of the Third-Harmonic Currents Which May Flow in Transformers and Transmission Lines—By Connecting One Side of a Transformer Bank in Delta Triple Currents Are Partially Short-Circuited

By D. I. CONE

THE behavior of harmonic currents of triple frequencies (third, ninth, fifteenth, etc.) arising in transformer banks with star or delta connections on three-phase systems, due to variation in permeability of the iron, is of considerable importance in several respects. Among the cases of interest are:

1. Inductive interference with communication circuits, paralleling electric supply lines.
2. Interference with relays installed in grounded neutral connections.
3. Prevention of overheating of delta-connected windings.

A number of examples are given to show how the triple-harmonic voltages and currents may be calculated and controlled by proper selection and connection of transformers for three-phase lines. While precise calculations are not ordinarily practicable, because of variations in quality of iron, and because under normal conditions a small change of voltage causes a change several times as great in the magnetizing currents, it is often possible to make fairly close estimates of the amount of triple-frequency currents under given conditions, especially with star-star connection and for the third harmonic, which is usually largest in size.

It is well known that the triple-frequency magnetizing currents of transformers in star or delta with three-phase balanced impressed voltages are in the same time phase in all three phases.* With the delta connection the winding of each transformer that is involved in the delta is effectively short-circuited, so far as the triple frequencies are concerned, and a delta circulating current is set up, as shown in Fig. 1 (a). With star connection and grounded neutral, these currents flow in the three star-connected windings in parallel, through the neutral connection, and complete their circuit through the impedance between lines and ground, which

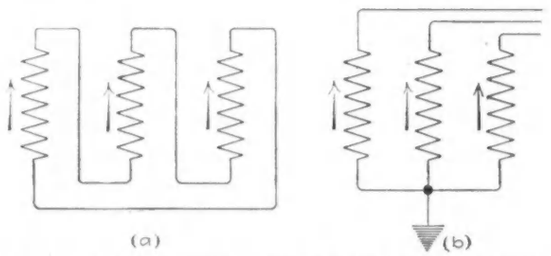


FIG. 1—TRIPLE-FREQUENCY CURRENTS IN (A) DELTA AND (B) STAR-CONNECTED TRANSFORMER WINDINGS

is determined by the capacitance to ground of the wires and by the impedances of other banks of transformers on the line, provided that their neutrals are grounded, as in Fig. 1 (b).

In the case of a star-star-connected transformer bank without grounded neutrals, or where the impedance to ground from the line connections is very large, the triple-frequency magnetizing currents cannot flow, consequently large triple-frequency voltages are induced in the transformers.

As an example, consider the third-harmonic neutral current to be expected from a bank of three 1,000-kva. transformers connected in star with grounded neutral on a 60-kv. line. At first assume the low-voltage windings to be star-connected as in Fig. 2.

*See "Transformer Magnetizing Currents," by J. F. Peters, *Trans. A. I. E. E.*, Vol. 34, page 2,157 (1915), or "Tertiary Windings in Transformers," by J. F. Peters, *Electric Journal*, November, 1919, page 477.

Present-day transformers at rated voltage and under conditions permitting free flow of the magnetizing currents develop a third harmonic magnetizing current of 30 to 50 per cent of the exciting current, which in turn is about 3 to 6 per cent of the full-load current. Hence a reasonable value of the ratio of third-harmonic magnetizing current to rated load current is 2 per cent. For a 1,000-kva. transformer the rated load current at $60/\sqrt{3}$ kv. is 29 amp.; hence 0.6 amp. third-harmonic magnetizing current is estimated. Where the third-harmonic current is prevented from flowing, the "open circuit" third-harmonic induced voltage amounts to 50 per cent or more of the fundamental voltage, or in this case say 18,000 volts. Thus the transformer may be regarded as a third-harmonic generator,† with a very large internal impedance of 18,000/0.6—that is 30,000 ohms—or about 10,000 ohms for the three phases in parallel.

With such large internal impedance the amount of third-harmonic current will not be materially altered by the impedance from lines to ground likely to be

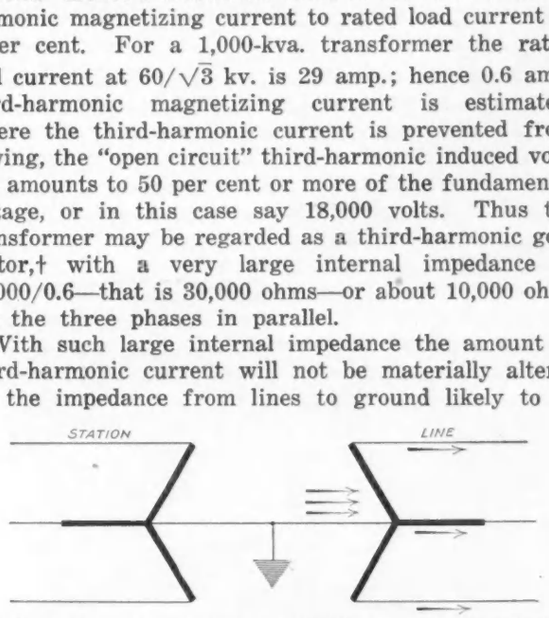


FIG. 2—CURRENTS OF TRIPLE FREQUENCY IN SYSTEM GROUNDED AT ONE END

experienced in practice. Thus, suppose the 60-kv. line to be 60 miles (96 km.) in length, with no other grounded neutrals. The capacitance per mile of the three wires in parallel to earth will be about 0.020 microfarads or 1.2 microfarads total, having a reactance at 180 cycles (third harmonic of 60 cycles) of 740 ohms, which will be approximately the line impedance if the neutrals of other transformer banks are isolated.

Usually, the low-voltage side of such a transformer bank offers relatively very high impedance, so that practically the entire third-harmonic current will flow in the high-voltage side. Hence the total third-harmonic neutral current arising in this transformer bank would be 3×0.6, or about 2 amp.

By changing the low-voltage transformer connections from star to delta the third-harmonic neutral current due to this bank will be, of course, greatly reduced. In this case there are two paths in parallel for the third harmonic:

1. Through the high-voltage windings and line to ground, the impedance being the line impedance to ground in series with that part of the "leakage" or "short-circuit" impedance of the transformers contributed by the high-voltage windings.

2. Through that part of the leakage impedance contributed by the low-voltage winding (the delta connection serving as a short circuit for the third harmonic).

Assuming the "impedance voltage" of the transformers to be 4 per cent, the impedance at rated load is 34,600/29, or 1,200 ohms, and the leakage impedance is $0.04 \times 1{,}200$, or 48 ohms, mostly inductive reactance (in terms of high-voltage windings, at 60 cycles). If the leakage impedance is divided equally between the high-voltage and low-voltage windings, it will be 24 ohms in each. For the third harmonic it will be about three times as great, or 72 ohms. The impedance of one line wire to ground is three times that of the three in parallel, or, for the case taken above, about 2,200 ohms, mostly capacitive reactance. Thus the delta side of each transformer offers an impedance (in terms of the high-voltage winding) of about 72 ohms, while the line side offers an impedance of about 2,200 — 70 = 2,130 ohms. Hence only about one-thirtieth of the total third-harmonic current should now follow the line side path.

While the process just outlined for the case of delta connection shows the general effect, it is very inaccurate, since inequalities among the transformers may change by several hundred per cent the amount of neutral current. It is evident that by reducing the part of the leakage impedance contributed by the delta-connected winding the amount of third-harmonic current in the lines can be lessened.

As shown in the papers by Mr. Peters, already referred to, core-type three-phase transformers star-star-connected behave like single-phase delta-star transformers in that the required triple harmonic magneto motive forces are supplied within the bank, hence the triple harmonic neutral currents are of the same order of magnitude as for delta-star banks.

Consider now the effect of connecting a star-delta bank, of the same size and kind, with grounded neutral, in parallel on the 60-kv. line with the original star-star bank. The impedance to the third harmonics from the star-star bank offered by the auxiliary star-delta bank is its leakage impedance. As given above, the leakage impedance per transformer is 48 ohms. For the third harmonic it is three times as great, but as the three transformers are in parallel, so far as the third harmonic is concerned, the bank impedance is 48 ohms.

The line impedance to ground for the case considered is 740 ohms, and the two paths are in parallel, so only about one-fifteenth as much third-harmonic current would flow in the line as for the star-star bank alone. It should be noted that the whole third-harmonic current would in this case flow in the neutral, though not on the line beyond the star-delta bank.

A much more elaborate and extensive treatment of this subject will be found in the technical reports of the California joint committee on inductive interference, recently published by the California Railroad Commission.

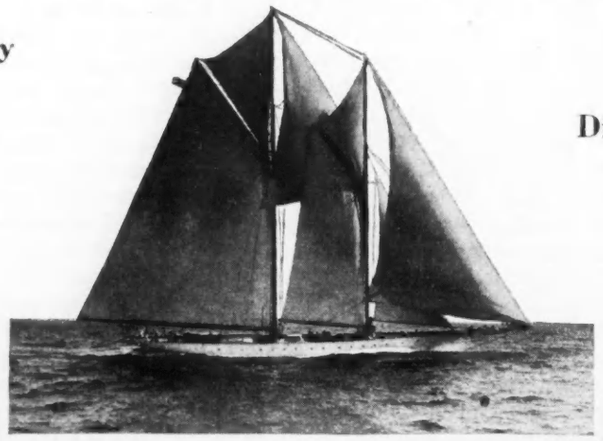
†See *Trans. A. I. E. E.*, Vol. 34, 1915, page 2,175, for detailed discussion by H. S. Osborne.

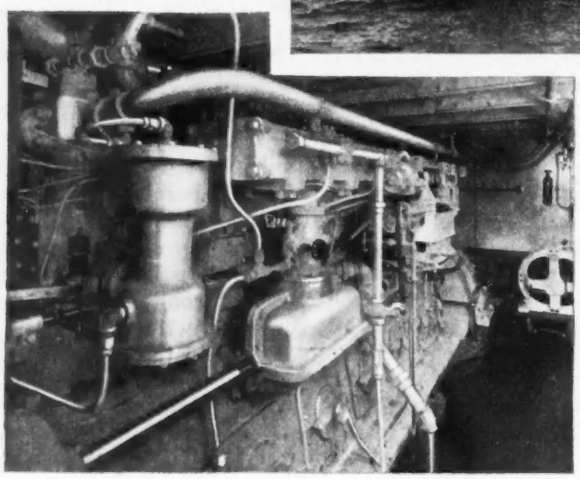
Experience with Aluminum Transmission Conductors

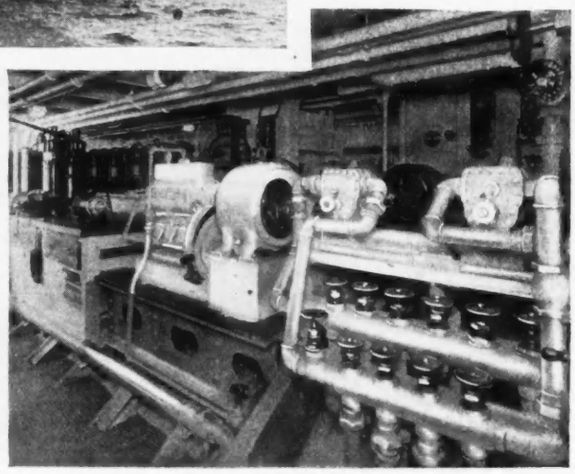
THE Iowa Railway & Light Company, Cedar Rapids, Iowa, has decided to adopt aluminum conductors for use on all transmission lines operating at 6,600 volts or more. The company already has 700 miles (1,100 km.) of aluminum conductors in use, and its experience with these circuits has been such that its engineers think the much-talked-of difficulties with aluminum wire will not arise. They argue that stranded aluminum conductor with a steel core, if purchased to give equal conductivity with copper, will have greater strength and give lighter loading on the poles than copper wire. They contend at the same time that aluminum is cheaper and easier to haul and handle in the field than copper. This is a considerable advantage, especially in handling reels of wire in outlying territory.

152 Ft. Yacht *Elfay*
Owned by
Russell A. Alger

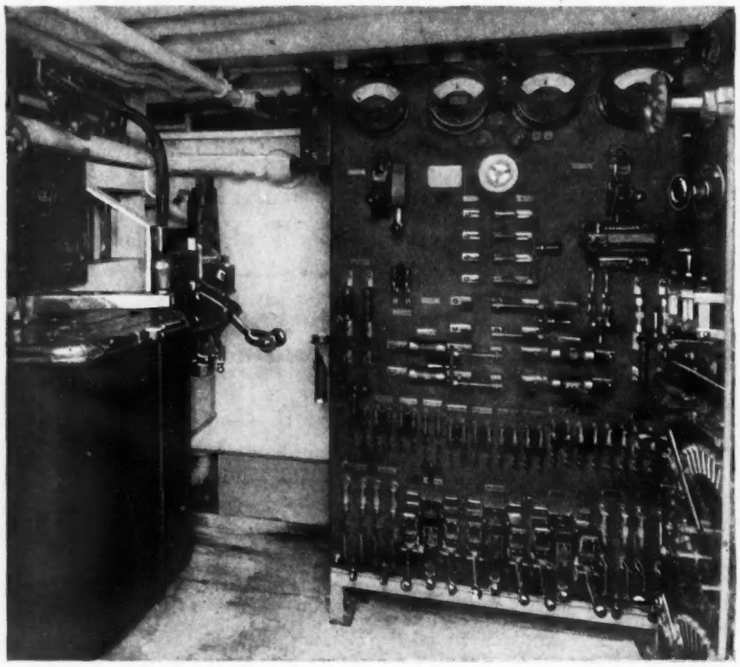
Driven by Motor
Operated from
Diesel-Generator Set

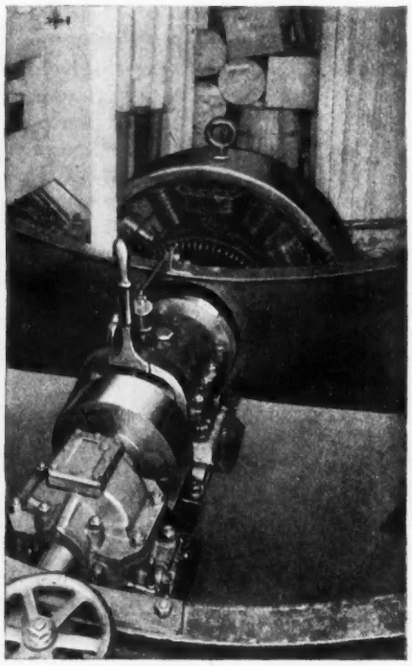






The drive includes a six-cylinder full-Diesel oil engine rated at 115 hp. and 425 r.p.m. and driving a 75-kw., 125-volt generator and exciter. The generator operates a 90-hp. motor, which drives the propeller through a clutch that disconnects the motor when the yacht is sailing.





The control station of this electrically driven yacht is situated on the deck just forward of the steering gear, where it is under the supervision of the navigator. Only the intensity and direction of the generator field is adjusted in controlling the yacht speed.

Rebuilding Old Motors

Owing to Severe Operating Conditions 150 Motors Had to Be Rebuilt in One Mill—Oil Troubles Eliminated by Changes in Bearing Design—Commutators Rebuilt to Increase Protection Against Oil

By JAMES DIXON

IN REBUILDING 150 old direct-current motors to make them meet the severe operating conditions encountered in steel-mill work many interesting problems were solved successfully and in a way that may be of interest to other industrial engineers. The method of working out the details was very satisfactory and has been adopted by a number of companies. There are many other industries whose equipment operates under similar conditions that may also apply similar modifications.

Graphite dust accumulating in the motors, thereby clogging oil wells and causing the oil to run out of the housings, was one source of trouble. The particular effect of this oil was to cause burn-outs in the front-collar insulation of the commutator. The trouble was somewhat intensified by the excessive zeal of the crane operators, as this company had made a practice of giving an enforced "lay-off" of two weeks to operators whose motor equipment was put out of service by a hot box. The natural result was the use of too much oil, not all of which reached the proper places.

The original journal boxes had a clearance space of $\frac{1}{32}$ in. (0.8 mm.) between the halves next to the shaft to insure the outside edges coming together. These were babbitt-lined cast-iron boxes. All were rebuilt

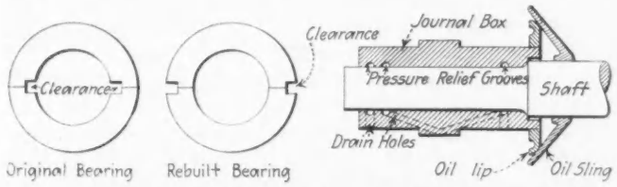


FIG. 1—CHANGES IN BEARING DESIGN

A—Clearance changed to outside eliminates squirting along shaft. B—Pressure-relief grooves drained by holes catch creeping oil. C—Oil lip catches oil forced from between box and housing. D—Flange to keep oil off commutator and windings.

with close joint next to shaft and clearance outside as shown in *A*, Fig. 1. This prevented oil squirting along the shaft, especially with geared motors.

Owing to the journal boxes being loose in the frame housings and their not being held firm by the lugs which are intended to keep the boxes from rotating, they rocked through a small angle, becoming abraded on the outside. To remedy this trouble the frames were scraped at the joints, and in some cases new and larger boxes were installed so that the frame would grip the boxes. This stopped the squirting of oil between frame and journal box.

Pressure-relief grooves, each drained by two holes, were added at both ends of each box. (See *B* in Fig. 1.) These catch any squirting or creeping oil and drain it back into the well. An oil lip (*C* in Fig. 1) was added to each bearing to catch any oil squirted from between box and housing, and an oil "sling" or flange (*D* in Fig. 1) was put on the shaft at each end to keep oil from the commutator and windings. These precautions were so effective that in six months' operation after the changes no oil was ever found on the oil "slings."

To prevent spattering of oil the web supporting the housing in the frame was grooved (see *A* in Fig. 2) both top and bottom, and a bigger and better oil overflow was designed to keep graphite out. The old overflow was a ¼-in. (6-mm.) hole. The new one was made of pipe fittings (*B* in Fig. 2) attached to the old ¾-in.

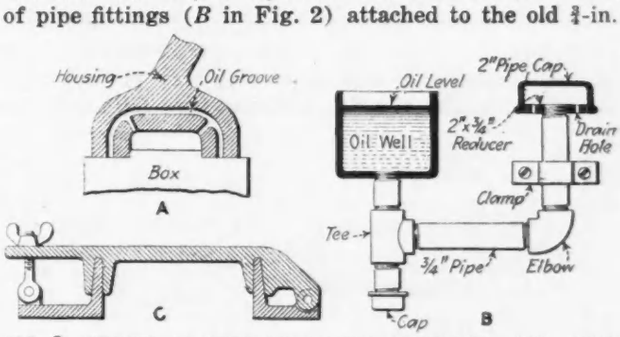


FIG. 2—DEVICES TO KEEP OIL WHERE IT BELONGS AND AWAY FROM DUST AND DIRT

A—Housing grooved to prevent spattering of oil. B—Overflow for oil designed to keep out dust and dirt. C—A cover that will enable oil to be put in easily and yet is dust-proof.

(19-mm.) drain-plug hole and firmly strapped to the frame. The cap on the end kept the graphite out. The overflow point was set ⅝ in. (15 mm.) below the bottom of the journal-box shell. A heavy, hinged, spring-closed, double-shrouded oil-hole cover was fitted to each bearing. This facilitated pouring oil in and kept graphite from falling in *C* (Fig. 2).

Commutators Rebuilt to Protect from Oil and Dirt

The old commutators were built with shellac which melted and ran out at high operating temperatures. As a result dirt collected in the space between the bars and collars, and in a comparatively short time the insulation broke down, grounding the bars to the motor frame. In

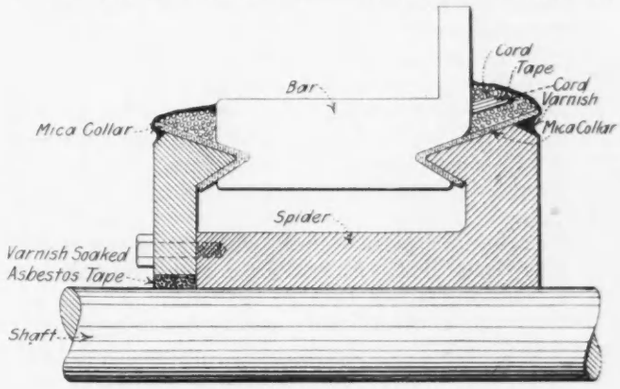


FIG. 3—METHOD OF REBUILDING COMMUTATOR TO PROTECT INSULATION FROM OIL

order to overcome this trouble the commutators were rebuilt as follows:

A clamp was placed around the commutator and the spider was removed. The V grooves were then cleaned by turning out on a lathe. Each V groove was then varnished with Sterling "extra elastic" insulating

varnish and baked until dry. New mica collars were then put in, and the spider was replaced and the clamps drawn tight. Two layers of cord were put on each collar and in addition at the back, as well as several layers of asbestos tape and more cord. One end was then brush-varnished with Sterling varnish and the commutator set with this end down and the other end filled and puddled with Sterling varnish until it would take no more. Then the commutator was baked and the screws were tightened. After the operation was repeated on the other end, the entire process was followed again so that each end had two puddlings and two bakings. As a result the cord was all smoothed over, all crevices were filled, and a big fillet of varnish was formed at the ends of the bars, as shown in Fig. 3. A commutator treated in this way is "seasoned" when finished by allowing sufficient time for the boiling

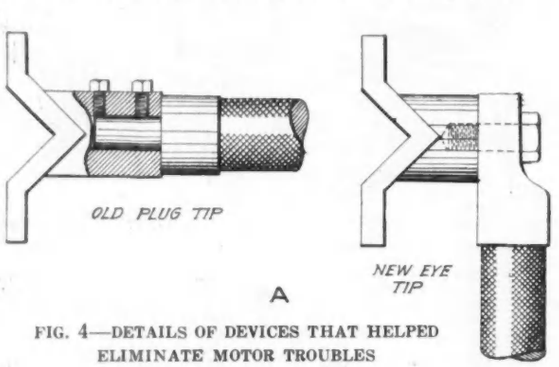


FIG. 4—DETAILS OF DEVICES THAT HELPED ELIMINATE MOTOR TROUBLES

out of the excess shellac and the settling of the mica laminations and will not change shape or loosen. After this treatment the commutator was turned true and mica undercut $\frac{1}{32}$ in. (0.8 mm.).

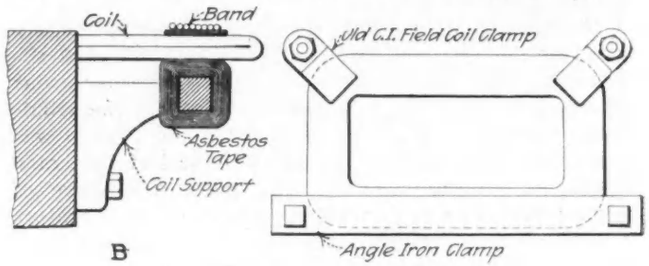
Another trouble which was encountered with nearly all these motors was known as "graying" of commutators. This was due to the mixture of oil and graphite forming a greasy, pasty surface on the brush-holders which kept the brushes from moving freely and as a result causing a poor contact with the commutator. Under these conditions the face of the commutator would lose its polish and become literally gray. If the trouble is not remedied the burning away of the commutator bars leaves high mica, which intensifies the trouble. In order to keep out the graphite and prevent the formation of this pasty surface, new hand-hole covers and frames with deep shrouds were made and bolted to the motors. The joint between the cover and frame was filled with steel cement. These covers, indicated as *C* in Fig. 3, stopped the graying of the commutators entirely.

The original armature cores, which were held together by pipe rivets, had weak end fingers and the ventilating duct spacers reached only to the bottom of the slots, allowing the laminations to spring apart or flare and close the ventilating ducts. To overcome this trouble the pipe rivets were replaced by insulated bolts, longer spacers reaching nearly to the top of the teeth were substituted, and new and stronger end-fingers were provided. The coil lashings were removed, grooves turned in the cores, and No. 14 phosphor-bronze core bands sunk flush with the core were bound on to hold the coils.

Steel-mill motors are often overspeeded, and experience shows that coil lashings are inferior to core bands if the speed attained exceeds twice the rated speed. The insulation used under the bands was asbestos tape with layers of mica between.

Considerable trouble was experienced with the original plug connections to the brush holders. The connector (*A* in Fig. 4) made what was practically a line contact with the cable, and as a result there was enough heating at times to cause burning of the cable insulation. The sockets were taped, as shown, and a heavy terminal was attached with stout cap screws. As an added precaution all cables inside the motor were taped with heavy asbestos tape, half lapped, and varnished with baking varnish.

A rear head-coil support (*B* in Fig. 4) was put on each armature and a cushion of insulation applied. This consisted of six layers of asbestos tape $\frac{1}{8}$ in. (3 mm.) thick and 2 in. (50 mm.) wide, with a single binding layer of narrower light tape. To avoid grounding of



A—Cable terminal that reduced heating and consequent burning of cable insulation. B—Coil support cushioned to reduce effect of vibration. C—Field-coil clamps that distribute pressure over a greater area.

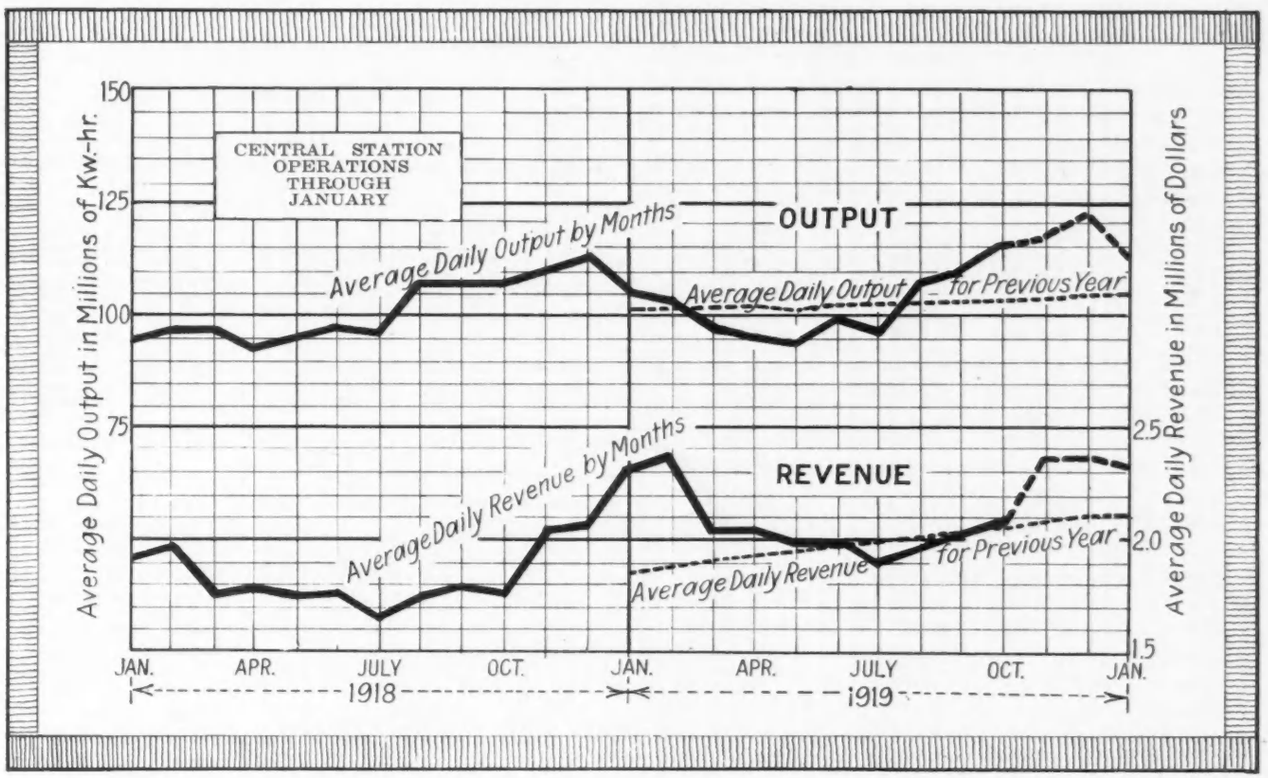
coils at slot ends, U-shaped mica reinforcements 0.025 (0.63 mm.) thick were placed around the coils. The armatures were rewound and after soldering were put in an oven to warm up and dry out. After this treatment each armature was varnished several times until it would not absorb any more varnish and was allowed to stand over night. After another coat had been applied it was baked for at least twelve hours and the bands were put on while armature was still hot.

The field coils required attention because they had grounded against the frame casting. As a solution for this difficulty washers of No. 10 duck with three coats of varnish were put in between the coils and the frame. The cast-iron field-coil clamps were removed and angle-iron pieces using the same bolts were inserted to distribute the pressure. (*C* in Fig. 4.) Pipe washers were put over the bolts to keep the angle-irons straight on the coils, and the bolts were reversed to bring nuts on the outside of the frame. Lock washers were put under the nuts and two nuts on each bolt.

As mill riggers will not trust eyebolts, such bolts were removed and plates were screwed over the holes to keep the graphite out. All other holes in the frames were covered by steel plates fastened with cap screws. This construction gives better results than riveting as screwed plates can be removed for inspection when desired.

TO ME *it is abundantly clear that there is no alternative between free competition and government ownership and operation. The control which the government has exercised over the railroads during the last fifteen or twenty years has in effect amounted to government operation. What has happened in the railway business will happen in every other business which the government undertakes to control.*—PHILIP CABOT.

New Year Begins with Large Gains



GENERAL prosperity is reflected in the returns from central stations received by the ELECTRICAL WORLD for the month of January. For seasonal reasons largely the January output was about 7 per cent less than for December. Probably the most striking figure derived from the returns is the large percentage of increase over January, 1919, due in part to the retrenchment which took place the first part of last year in all lines of industry. It is apparent from all reports that this slump has been more than overcome and that the central-station industry in all probability must prepare to meet largely increased calls for energy from manufacturers in the near future.

With the settlement of the coal and steel strikes business in general commenced the new year on a better basis than at any time since the armistice, which resulted in a demand for electrical energy in excess of that rendered at any time during the war period in all sections of the country except the Mountain States. The New England section showed a remarkable gain of 30.7 per cent over January of 1919. A study of this section indicates unusual prosperity in virtually all lines of industry. The textile mills operated approximately 100,000 more spindles in January than in any previous month and were reported as working at around maximum capacity. All industries in this section appeared to be rushed. All but two central stations in this section reported a largely increased energy demand, the two exceptions being small stations with only a local demand, which for the most part is for lighting.

The Atlantic States also recorded a large gain over the previous January, but not so pronounced as in the New England States. Steel mills as a whole were working at between 85 and 90 per cent capacity at the end of January against 80 per cent capacity at the beginning of the month and an average of not over 60 per cent capacity during the last three months of 1919. With the settlement of the coal and steel strikes business in general was in the best shape for months, and a large majority of the factories of all kinds were reported as working at capacity, resulting in a near maximum demand for power.

Returns from the Central States indicated remarkable prosperity throughout the section. In the Great Lakes manufacturing centers almost every factory was again working at maximum capacity. Extensive expansions were made during the winter to many of the zinc refineries in Wisconsin and Minnesota, and drills were operating extensively at all the mines, resulting in an 80 per cent increased demand in January for electrical energy in that section. In the South Central States large additions were made to the existing central-station plant capacity during the first part of the month, and many factories of all classes in this section were reported as changing over to electric drive.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Installed Capacities Represented	Revenue from the Sale of Energy			Percentage of Installed Capacities Represented	Kw.-Hr. Output		
		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase
Jan.	48	$34,209	$28,400	20.1	48	1,562,563	1,396,338	12.1
Feb.	45	29,929	24,570	20.1	45	1,309,945	1,214,414	8.0
Mar.	45	28,579	24,447	17.3	45	1,359,296	1,340,210	1.0
Apr.	45	27,740	23,919	16.0	45	1,279,274	1,240,782	2.9
May	45	27,795	24,291	15.5	45	1,306,622	1,314,216	—1.0
June	47	28,175	24,701	14.1	47	1,399,951	1,367,908	2.3
July	44	25,794	22,568	14.1	44	1,309,301	1,281,874	2.0
Aug.	54	32,756	29,006	13.0	54	1,801,836	1,793,706	0.5
Sept.	53	32,344	28,336	14.0	53	1,761,582	1,695,862	4.3
Oct.	55	35,492	30,077	18.0	60	2,175,636	1,987,004	9.0
Nov.	53	37,439	31,927	17.2	58	2,055,428	1,895,693	8.2
Dec.	52	38,252	33,024	15.9	58	2,218,101	2,027,869	9.2
		1920	1919			1920	1919	
Jan.	46	33,557	28,088	19.5	52	1,840,953	1,572,555	17.0

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Installed Capacities Represented.	New England States 1919	New England States 1918	Per Cent Increase.	Percentage of Installed Capacities Represented.	Atlantic States 1919	Atlantic States 1918	Per Cent Increase.	Percentage of Installed Capacities Represented.	Central States 1919	Central States 1918	Per Cent Increase.	Percentage of Installed Capacities Represented.	Pacific and Mountain States 1919	Pacific and Mountain States 1918	Per Cent Increase.
REVENUE	Jan.	70	4,106,000	3,412,000	20.3	46	13,736,000	11,412,000	20.0	40	11,004,000	8,931,000	23.3	60	5,363,000	4,645,000	15.5
	Feb.	71	3,908,000	3,052,000	28.0	45	12,475,000	10,243,000	21.2	36	9,349,000	7,520,000	24.0	54	4,197,000	3,755,000	12.0
	Mar.	71	3,561,000	3,020,000	17.9	44	11,809,000	10,312,000	14.5	36	8,991,000	7,430,000	20.9	54	4,218,000	3,685,000	14.1
	Apr.	71	3,468,000	2,942,000	17.8	43	11,516,000	10,213,000	12.3	36	8,427,000	7,009,000	20.3	56	4,329,000	3,755,000	16.5
	May	70	3,190,000	2,781,000	14.9	43	10,817,000	9,826,000	10.1	36	8,320,000	6,910,000	20.5	56	5,468,000	4,764,000	14.2
	June	71	3,317,000	2,904,000	14.1	43	10,605,000	9,537,000	12.0	38	8,757,000	7,504,000	16.2	63	5,496,000	4,767,000	15.2
	July	70	3,406,000	2,995,000	13.7	40	9,320,000	8,375,000	12.0	38	8,854,000	7,442,000	19.0	49	4,214,000	3,756,000	12.1
	Aug.	74	4,225,000	3,693,000	14.4	57	12,174,000	10,995,000	11.1	45	10,942,000	9,309,000	17.1	61	5,415,000	5,009,000	8.5
	Sept.	73	4,019,000	3,536,000	13.6	53	11,429,000	10,069,000	13.5	44	11,395,000	9,766,000	16.2	63	5,501,000	4,965,000	10.9
	Oct.	72	4,127,000	3,453,000	19.1	53	12,684,000	10,822,000	16.9	50	13,241,000	11,003,000	20.1	62	5,440,000	4,799,000	13.9
	Nov.	71	4,432,000	3,800,000	16.2	56	14,738,000	12,761,000	15.7	44	12,604,000	10,383,000	22.1	63	5,665,000	4,983,000	13.9
	Dec.	73	4,878,000	4,223,000	15.9	51	13,849,000	12,079,000	14.4	39	10,420,000	8,734,000	19.4	77	9,105,000	7,988,000	14.0
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	71	5,026,000	4,221,000	19.2	47	13,302,000	11,041,000	20.0	36	9,987,000	8,402,000	20.9	56	5,242,000	4,424,000	18.3
			1919	1918			1919	1918			1919	1918			1919	1918	
KW.-HR. OUTPUT	Jan.	70	140,959,000	122,115,000	15.4	46	536,772,000	467,923,000	14.8	40	488,517,000	429,318,000	14.0	60	396,315,000	376,982,000	5.3
	Feb.	71	129,196,000	110,233,000	17.2	45	460,628,000	425,520,000	8.1	36	427,934,000	379,953,000	12.3	54	292,187,000	298,708,000	-2.0
	Mar.	71	125,411,000	122,541,000	2.3	44	461,567,000	462,972,000	-0.1	36	441,604,000	422,928,000	4.1	54	330,714,000	331,769,000	-0.3
	Apr.	71	123,111,000	116,411,000	5.7	43	431,572,000	424,049,000	2.0	36	382,779,000	358,858,000	6.9	56	341,812,000	341,464,000	0.1
	May	70	120,856,000	120,908,000	-0.1	43	413,043,000	430,729,000	-3.9	36	390,667,000	377,525,000	3.6	56	382,056,000	385,054,000	-0.9
	June	71	127,260,000	119,217,000	6.7	43	408,335,000	419,060,000	-2.5	38	418,542,000	386,422,000	8.0	63	445,814,000	443,209,000	0.5
	July	70	141,551,000	130,393,000	8.2	40	373,105,000	378,053,000	-1.5	38	428,370,000	408,165,000	5.3	49	366,275,000	365,263,000	0.1
	Aug.	74	161,431,000	153,266,000	5.1	57	640,616,000	662,120,000	-3.2	45	555,763,000	513,591,000	8.1	61	444,026,000	464,729,000	-4.2
	Sept.	73	153,837,000	146,209,000	4.5	53	610,254,000	610,179,000	0.1	44	573,835,000	518,767,000	11.0	63	423,656,000	420,707,000	0.5
	Oct.	72	162,859,000	142,326,000	14.4	53	694,584,000	659,859,000	5.3	62	882,439,000	766,407,000	15.2	62	435,754,000	418,412,000	4.1
	Nov.	71	153,171,000	140,240,000	9.2	56	724,607,000	707,347,000	2.4	56	754,838,000	657,362,000	14.8	63	422,812,000	390,744,000	8.2
	Dec.	73	177,874,000	149,648,000	18.5	52	705,044,000	661,334,000	6.5	53	723,737,000	619,764,000	17.5	77	611,446,000	597,123,000	2.2
			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	71	183,502,000	140,369,000	30.7	48	633,509,000	552,261,000	14.5	50	675,651,000	593,257,000	14.0	56	348,291,000	286,668,000	21.4

Output for the Pacific and Mountain States was 21.4 per cent above that recorded in January, 1919, although the copper industry was operating at only about 50 per cent capacity. This lack of demand for energy in the copper regions was overcome to a large extent by largely increased operations in the zinc regions. Almost all the central stations of the Pacific Coast States reported increased output over December, reflecting the general prosperity of that section of the country.

In line with its constant endeavor to present the most reliable data possible on central-station operations, the ELECTRICAL WORLD has made a recompilation of the central-station returns for the years 1918 and 1919, based on the latest data obtainable pertaining to the installed capacity of the electic light and power plants of the country. Such a correction will be made at regular intervals as the installations of the central stations are increased. The output and revenue figures in Tables I and II are the results of this recompilation. According to these figures the total central-station output in 1919 was 38,559,000,000 kw.-hr. and the revenue was $773,000,000.

Running 42-Cycle Induction Motors from 25-Cycle Supply

IF A 42-cycle induction motor is operated at its normal voltage, but from a 25-cycle distribution system, it will take an excessive magnetizing current, heat up and run inefficiently. According to J. Mathivet (*Revue Générale d'Electricité*, Nov. 22, 1919), however, if the impressed voltage is reduced in a proportion equal to the square root of the ratio of the frequencies the motor will give much the same characteristics as if run at its rated frequency and voltage, and although at full rated output the motor will absorb about 28 per cent more than rated current, it will, as a rule, run in a perfectly satisfactory manner.

In order to be able to interconnect two distribution systems of respectively 42 cycles and 2,500 volts and 25 cycles and 5,000 volts, without discarding any motor equipment, the Compagnie des Mines d'Anzin, in dropping the 42-cycle supply, installed 25-cycle, 5,000/1,950-volt transformers and simply ran its motors, through these transformers, from the 25-cycle system. Of course, the pulleys had to be changed in the ratio 25 to 42.

The plan is said to work well, and in this connection it is pointed out that a very high economy is reached. While a frequency changer, notwithstanding its higher cost, will only reach an efficiency of about 85 per cent, a transformer will give up to 97 per cent efficiency. Even if the efficiency of the individual motors is slightly impaired by the change in frequency, the total economy thus is very good.

The same company later was confronted with the problem of utilizing a number of 25-cycle, 220-volt, induction motors on a 50-cycle system of the same voltage. If the same principle is again applied to this new problem, we find that the motors should be operated at $220\sqrt{2}$, or 310 volts. Since it is difficult to obtain 220/310-volt transformers, however, the motors were instead changed over from star to delta connection, which has the same effect as a transformation of the voltage in the ratio $\sqrt{3}$, and, by choosing small conductors for the transmission, an artificial drop of voltage was obtained, so that the impressed voltage was substantially correct.

By simply adding to the plant a static transformer of suitable ratio of transformation, an induction motor drive, designed to operate on a certain frequency, may cheaply be adapted to a system of supply of another frequency, provided, of course, that the motor will stand the change in speed and voltage.

Readers' Views and Comments

The Old Socialism and the New

To the Editor of the ELECTRICAL WORLD:

SIR: Students of social economics were once wont to exclaim at the ignorance of those in America to whom socialist, communist and anarchist were synonymous terms. They were right in pointing out the wide differences in the creeds of these schools of radical thought. None the less, the whirligig of time has brought about in a totally unforeseen manner a condition that might almost be said to justify retroactively the mental attitude of the persons who refused to make distinctions. For the socialist party in America today has been swallowed up by its "left" or communist branch, which proclaims a belief in the Russian soviet system, and if that system in its first stages had really anything about it that distinguished it from anarchism it was not perceptible at this distance from Moscow, though it is true that it appears to have eventuated—as anarchy may always be trusted to do—in a species of despotism.

The American socialism of other days, the leaders of which quite generally cut loose when in war time the party broke from their guidance and adopted a disloyal and virtually pro-German platform, was, in a nation of born individualists, an exotic affair which served its chief purpose, as some thought, in providing a means of protest for voters when they deemed both of the large parties too subservient to the "interests." Many persons, influenced by the books of imaginative writers like Edward Bellamy, thought of the socialist party as one working for an ideal state of human existence through the destruction of monopoly and the abolition of the fear of want. Universal brotherhood, prosperity and happiness were conceived to be its object, and in this aim, however visionary, lay no treason to the state. The mistake, of course, lay in putting the cart before the horse—in assuming that all-pervading virtue would follow ideal political arrangements, when obviously it must precede them. If the great majority of mankind ever become both virtuous and intelligent, Utopia will come automatically. So long as those who are virtuous but not intelligent, those who are intelligent but not virtuous and those who are neither intelligent nor virtuous make up a combined majority, Utopia will remain a dream and in human affairs an ounce of amelioration realized will be worth a ton of perfection imagined.

It cannot, however, be said that our present-day socialists, with their allegiance to communist or bolshevik theories, make the mistake to which allusion has just been made. They neither claim nor inculcate virtue, and their propaganda is founded not on any principle of fraternity but solely on "proletarian" rights and revenges. Malice, envy, sloth and hatred are its procreating forces —sometimes naked and unashamed, sometimes disguised so that even those they dominate fail to recognize them for what they are. There is no fear that theories thus predicated and thus fathered will gain the upper hand in these United States; but it behooves our governing bodies by an unswerving recognition of the political rights even of those whose theories they detest, by a determined effort to uproot legalized social injustice wherever it may have taken root, and by ample provision for the Americanization of immigrants whose mental processes still bear the imprint of European conditions, to cut away the soil from which such growths spring. In this patriotic process public utilities employing hundreds of more or less newly made citizens can immensely help.

FRANK W. CHASE.

Brooklyn, N. Y.

Power Resources in Arizona

To the Editor of the ELECTRICAL WORLD:

SIR: The development of Arizona coal resources has been a matter of only passing interest hitherto, since it was overshadowed by the tremendous output of the state's metal mines. There are at least three places in the state, however, where coal is found in large quantities, and when the Gallup fields of New Mexico commence to give out and there is a local demand for power for manufacturing and for agricultural purposes activity is bound to be directed toward the development of these deposits. The great possibility offered by them would seem to lie in erecting power plants at the mines from which energy could be transmitted by high-tension lines to other parts of the state for various purposes, including artificial refrigeration. Energy might also be used to recover nitrogen from the air right at the plant.

The Black Mesa coal field lies in and around Black Mesa in the Hopi and Navajo Indian reservations in Coconino, Navajo and Apache Counties. At present the field is difficult of access. The Sante Fé railroad lies 70 miles to 90 miles (112 km. to 144 km.) south. This coal is as good as or better than that from the Gallup mines. The Pinedale coal field is in two beds. The upper is a very dirty deposit, while the lower is fairly clear and of good sub-bituminous quality. The Deer River coal field lies on the south side of the Gila River at its confluence with the San Pedro. It is about 85 miles (135 km.) northeast of Tucson. The eastern end of the field is accessible from San Carlos through Hawk Canyon.

The coal field is near the center of the great copper-producing region of the state. The total tonnage is estimated at 30,000,000 short tons. The coal is, generally speaking, of two qualities. The first is hard block coal adaptable for transportation, for commercial use and for coke making. The second is a soft coal, badly crushed, and is of little use for marketing, although it offers possibilities for manufacture of gas and for use in a power plant at the mine. The fact that these fields occur on Indian reservations injects a point of difficulty, but efforts are being made by prominent engineers of Arizona, among whom is Dean G. M. Butler, director of the Arizona Bureau of Mines, to have legislation passed that will permit these mines to be developed and worked, the Indians being at the same time properly recompensed for them.

Arizona is a state of great wealth and natural resources. It is waiting for the hand of the engineer to develop it, not merely along manufacturing and engineering lines but in agriculture as well. Cheap power will do it.

PAUL C. COKE.

Tucson, Ariz.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Overcharging Battery 100 Per Cent Reduces Life 15 Per Cent

CHARGING at other than normal rate is the most destructive factor to the life of lead-and-acid storage batteries. It has been ascertained that practically no disintegration of battery plates takes place in discharge, but a variation from normal charging rate causes sluffing of the material with consequent shortening of life. Sluffing is due to gassing within the plate,

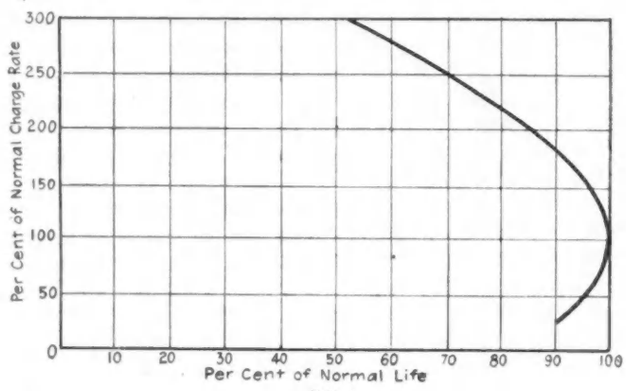


FIG 1

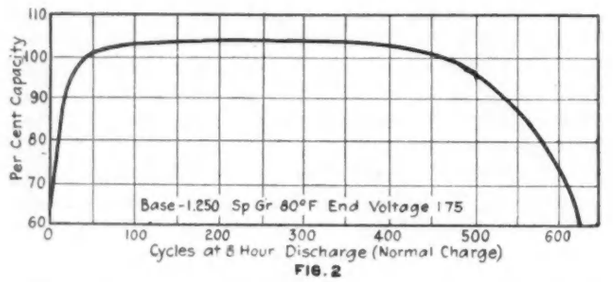


FIG. 2

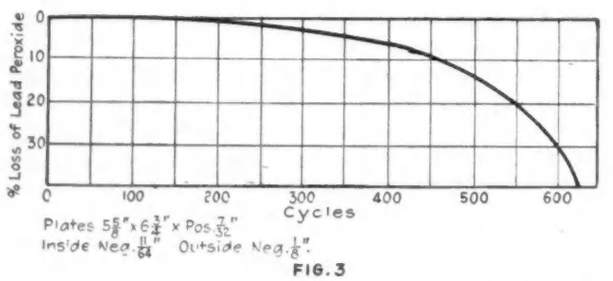


FIG. 3

FIG. 1 — LIFE OF BATTERY COMPARED WITH CHARGING RATE. FIG. 2—CAPACITY AFTER NORMAL CHARGE. FIG. 3—AMOUNT OF SLUFFING THAT HAS OCCURRED AT NORMAL CHARGE

which is a natural phenomenon of charging; but overcharging, which is passing more current than can be absorbed in the normal chemical reduction of lead sulphate to lead oxide, produces excessive gassing. This is evidenced by a milky appearance of the electrolyte, which increases sluffing in greater proportion than the charge rate is increased, and the life of the battery depends on the amount of this sluffing. It will be seen from Fig. 1, showing the variation of life with different rates of charge, that charging either above or below normal rate shortens battery life. The two other curves show the amount of sluffing and the percentage capacity of a paste cell which has been charged normally. The horizontal ordinates represent the number of cycles (charge and discharge) through which the battery has passed, and the vertical ordinates represent respectively the battery capacity and the amount of sluffing that has taken place.

P. L. RITTENHOUSE

New York, N. Y.

Fuel is 52 Per Cent and Labor 18 Per Cent of Operating Expenses

OPERATING expenses of a municipal company with 1,070 kw. in generators are given in the accompanying table and show that the two outstanding expenses are coal, 51 per cent of the total, and labor, totaling almost 18 per cent. The generating equipment of this company, which operates in the borough of Wallingford, Conn., consists of a 450-kw. engine-driven generator, a 500-kw. turbo-generator, both fed by boilers rated at 725 hp. total, and a 120-kw. water-wheel unit. The yearly output in this town

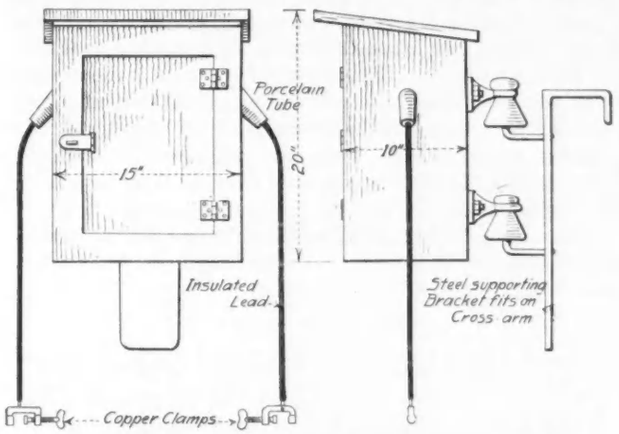
OPERATING EXPENSE OF 1,070-KW. MUNICIPAL COMPANY

	Per cent	
Maintenance:		
Electric equipment	0.35	
Steam Equipment	5.41	
Line equipment	3.23	
Station and buildings	2.38	
Street lamps	2.89	
Meters	2.07	
Fire alarm	0.53	
Total maintenance	16.86	
Fuel		51.23
Oil and waste		0.45
Labor:		
Steam plant		15.88
Water plant		2.83
Salaries		5.47
Office rent		0.05
Insurance:		
Liability	0.95	
Compensation	1.30	
Boiler	0.13	
Building	0.59	
Total insurance	2.97	
Miscellaneous expense		4.37
Total		100.00

of 10,000 people for a connected load of 3,336 kw. was 1,273,000 kw.hr., with a consumption of 2,887 tons of coal costing $8.83 per ton. This energy is distributed over about 28 miles (45 km.) of primary lines. These expenses included maintenance and operation of 257 street incandescent lamps, 208 of these being 100-watt tungstens.

Maximum-Demand Outfit Installed Without Interrupting Service

FOR obtaining the maximum demand on a transformer serving several customers an outfit which can be hung on a cross-arm near the transformer is used by the Merchants' Heat & Light Company,



HANGS ON CROSS-ARM TO METER MAXIMUM DEMAND

Indianapolis, Ind. This apparatus is installed without interrupting service as follows:

A Wright demand indicator is mounted inside a wooden box, the flexible insulated leads passing from the indicator through porcelain bushings in the sides of the box and terminating in copper clamps. The box is supported by two insulators mounted on a bracket which will hang on the cross-arm. As the box is hung near one of the 2,400-volt fuses which are in the transformer leads, only short connectors are necessary. The insulation is cleaned from the wires on the line side and the transformer side of the fuse, and the two clamps are screwed to these two wires. Then the fuse is pulled and the fuse wire is removed.

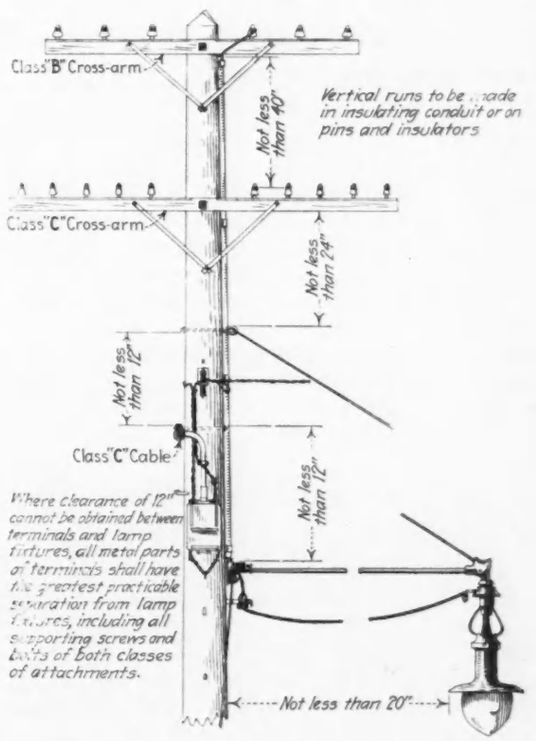
Tentative Specifications for Joint-Pole Lines

TENTATIVE specifications covering construction of jointly used pole lines for electric supply circuits and signal circuits have been compiled by the engineering committee of the Pennsylvania Association and the American Telephone & Telegraph Company. This is one of few instances where such information has been compiled, the Connecticut code being one of the most prominent cases.

In the general specifications included in this report the circuits are classified as follows: Class B, constant-potential currents not exceeding 5,000 volts between wires and constant-current circuits not exceeding 7.5 amp.; Class D, constant-potential, direct-current trolley contact wires and feeders not exceeding 750 volts to ground; Class C, commercial telephone, telegraph call-box or other signal circuits for public use, and Class P, private telephone or signal circuits. The relative positions on a pole to be occupied by attachments of the different classes in most cases are from top to bottom as follows: Class B, Class C and Class D. In most cases the rules provide that the distance between Class B and Class C cross-arms should be not less than 48 in. (1.2 m.) from center to center and for other attachments with the exception of cross-arm braces and guys the distance should be not less than 40 in. (1 m.). Between Classes C and D these two distances must be the same in both cases. In further reference to vertical clearance the report says that line wires or suspension wires of different classes where strung at different sags shall have vertical spacings at the supporting structure so adjusted that the minimum spacing at any point in the span at 60 deg. F. (15 deg. C.) with no wind shall not be reduced more than 25 per cent from these values.

The ruling concerning climbing space on the pole says that there must be a space of at least 30 in. (75 cm.) on one side or corner of the pole for this purpose.

The section devoted to attaching live wires on cross-arms provides that single-line arms shall be carried on the same side of the pole and that generally lightning protection wires should be attached to insulators on cross-arms. A further requirement made is that all live wires carried on cross-arms shall clear the pole at least 5 in. (13 cm.). Class B secondary


Class "B" Cross-arm
Not less than 40"
Vertical runs to be made in insulating conduit or on pins and insulators
Class "C" Cross-arm
Not less than 24"
Not less than 12"
Class "C" Cable
Not less than 12"
Where clearance of 12" cannot be obtained between terminals and lamp fixtures, all metal parts of terminals shall have the greatest practicable separation from lamp fixtures, including all supporting screws and bolts of both classes of attachments.
Not less than 20"

ARC LAMP BELOW CLASS C ATTACHMENTS ON JOINTLY USED POLE, SHOWING USE OF INSULATING CONDUIT FOR VERTICAL RUN

wires not exceeding 250 volts to ground may be carried on insulators supported on metal brackets or rails attached directly to the pole. If class C wires are insulated properly, they can be attached directly to the pole.

Concerning guys the committee decided that all guys

except anchor guys shall be preferably attached to non-conducting supports so placed and maintained that no part of any guy shall come within 8 ft. (2.4 m.) of the ground. In addition, all guys shall be so placed as to maintain a clearance of at least 6 in. (15 cm.) from the nearest live wire on the guyed pole, and every guy which passes over or under any electric wires other than those carried upon the guyed pole

FLASHOVER VOLTAGES OF INSULATORS ON CLASS A CIRCUITS

Voltage of Circuit	Flashover Voltage Dry	Flashover Voltage Wet
6,600	40,000	30,000
7,500	45,000	33,000
11,000	60,000	45,000
22,000	110,000	83,000

shall not at any time come within 2 ft. (60 cm.) of the said electric wires. A further requirement is made that the strain insulators to be used in guys should not flash over at twice the maximum line voltage.

When supply voltages exceed 500 volts the circuits

SAGS AT 60 DEG. F.

For medium and hard-drawn covered copper wires:

	Span Lengths								
	100	125	150	175	200	250	300	400	500
No. 6	18	27	40	..	..	..	..	..	..
4	12	18	27	36	48	..	..	..	..
2	12	18	27	30	36	60	96	..	..
1	12	18	26	29	33	52	80	..	..
00	12	18	25	28	31	46	66	..	..
0000	12	18	24	27	30	38	50	..	..

For soft-drawn covered copper wires:

	Span Lengths								
	100	125	150	175	200	250	300	400	500
No. 4	21	32	48	..	..	..	..	..	..
2	18	27	40	54	..	..	..	..	..
1	15	22	33	45	60	..	..	..	..
00	12	18	25	33	42	..	..	..	..
0000	12	18	24	30	36	..	..	..	..

For medium and hard-drawn bare wires:

	Span Lengths								
	100	125	150	175	200	250	300	400	500
No. 6	12	18	27	..	..	..	..	..	..
4	10	15	21	28	38	71	15	..	..
2	10	15	18	21	24	44	68	138	228
1	10	15	18	21	24	40	59	120	204
00	10	15	18	21	24	36	50	102	168
0000	10	15	18	21	24	32	42	84	132

are known as Class A. The vertical clearance required is 72 in. (1.8 m.) between cross-arms and 60 in. (1.5 m.) between other attachments.

Insulators used on the Class A circuit shall be capable, says the report, of withstanding without flashover, at a frequency of 60 cycles, voltages not less than those listed in the accompanying table.

Load Regulated by Headgate When Governor Control Fails

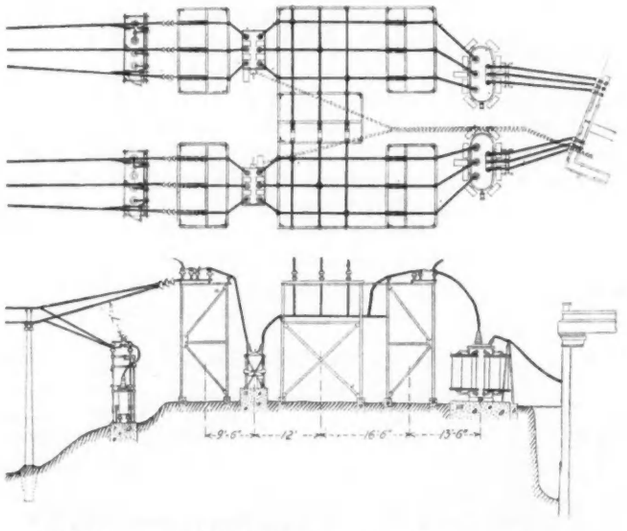
DEFECTIVE gate control on a water turbine-generator does not necessitate complete shut-down of the machine if care is used in its operation. The cause of defective operation may be that a governor has burned out a bearing or stripped a gear or that a regulator valve is sticking. If this is the case, hand control can be used generally, but sometimes the gates cannot be operated by hand. Then the headgates must be depended on. If the generator tends to run away, these gates should be closed before opening the generator circuit breaker. In a runaway machine the roller bearings are likely to be damaged, although slide bearings will not be. On the other hand, if the generator is loaded so heavily that it does not overspeed and if it is needed on the line to carry the load, it may be left in operation. However, it should be watched and it is advisable to reduce the number of open headgates as much as possible to carry the load. A man should be posted at the headgates ready to close them in case the load drops off the machine. In addition, if the layout permits, a large water rheostat may be held ready to tie to the machine to prevent runaway in case of sudden loss of load.

These directions refer only to a machine already connected to a system, but it may be necessary sometimes to start up a defective machine in order to take care of an increasing load on the plant. If it is necessary to connect such a crippled machine to the system, it may be synchronized and its load may be regulated by operation of the headgates. After the wheel pit is filled with water the gates have to be opened only a slight distance to attain synchronous speed. Another method of paralleling such a generator is to tie it to a generator whose control is in good condition while both generators are at a standstill. Both machines should have strong fields for best results. After connecting the machines together the good one is brought up to speed and the crippled machine will keep in synchronism with it. When both are up to speed they are synchronized with the station bus and tied to it simultaneously.

These directions are taken from rules of the Pennsylvania Water & Power Company, for use in the Holtwood (Pa.) plant of that company.

Simple Design for Outdoor Substation

AVERY desirable arrangement of lines and apparatus is obtained in the outdoor substation at the McClure plant of the Cleveland Cliffs Iron Company, Ishpeming, Mich. The two 5,000-kva. three-phase transformers are fed from separate lines connected to the 2,200-volt generator bus by switches inside the station.



10,000-KVA., 2,200/30,000-VOLT OUTDOOR SUBSTATION

The outgoing 30,000-volt lines may be tied together on the outdoor tie bus. Beyond this tie are the line automatic oil switches, choke coils and lightning arresters.

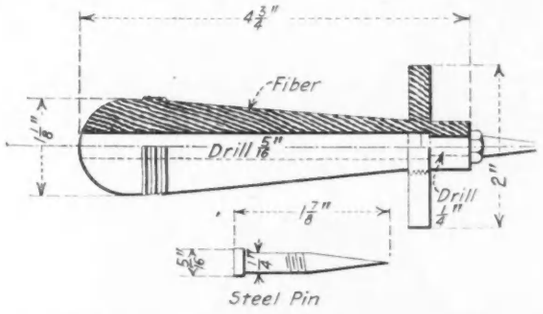
This design brings out the simplicity of arrangement which may be obtained where space is not limited. The apparatus is arranged in a logical order so that mistakes by operators or repairmen are not probable. The substation was designed by F. C. Stanford, electrical engineer for the Cleveland Cliffs Iron Company.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Fiber Handles for Reading Voltage Without Cutting Insulation

LEADS attached to fiber handles holding steel points have been found very convenient in a Michigan copper mine for making voltage readings with portable instruments. The sharp steel point assures a firm contact on bare buses and pierces ordinary weatherproof insulation so that cutting the insulation is unnecessary. On 2,200-volt tests the insulating handle reduces the danger and allows quick work. In making the handle, it is drilled lengthwise so that the steel pin to which the flexible lead wires are soldered may be passed through it, point first, until the pin's shoulder rests on a shoulder in the handle. After this it is drawn up tight with the hexagonal nut on one end of the handle. Terminals are soldered on the other end of the lead wires for use with the instruments or transformers.



INSULATED HANDLES FOR USE WITH VOLT METERS

JOHN E. ROCK,
Electrical Foreman.
Copper Range Company,
Painesdale, Mich.

Calculating Proper Size of Motor for Irregular Loads

IN CALCULATING the largest irregular load which a motor can carry the most important factor is the temperature which the insulation will reach. The maximum temperature to which insulation should be subjected is 105 deg. C., and motors are usually so rated that a continuous overload of about 15 per cent will give this temperature. However, where the load varies, the heavy load being carried only part of the time, the motor may be smaller since part of the heat developed under the heavy load will be dissipated during light load. The effective load is dependent on the resultant heating, and if the load cycle is known this effective load, called the "root-mean-square" load, may be calculated.

The following example will explain the method of calculating the load for a 75-hp. direct-current motor rated at 220 amp., 230 volts, which drives a chain bench, drawing two bars of soft steel, of $2\frac{1}{16}$ in. diameter to 2-in. finished size:

Load	Seconds	Volts	Amp.	Kw.	(Kw² Sec.)
Friction ...	25	215	40	8.6	1,848
Drawing ..	50	175	450	78.7	309,185
Total ...	75				311,033

Adding the sums of the squares of each load multiplied by the seconds, the result is 311,033. Then, dividing and extracting the square root, $\sqrt{311{,}033 \div 75}$, or 64.4 kw., is found as the effective load. As the motor is rated at 62.2 kw., it is properly loaded. This method must not be applied to a motor used intermittently, because when at rest a motor does not cool as quickly as when running unloaded on account of lack of ventilation. In this case another formula must be used, effective load = kw. $\sqrt{t_l \div t_l k t_r}$, where kw. = power demand on loaded t_l = time running loaded, t_r = time standing still, and $k = 0.5$ for inclosed motors and 0.33 for open motors.

D. W. BLAKESLEE.
Pittsburgh, Pa.

Convenient Transformer Mounting in Factory Testing Department

IN A MASSACHUSETTS factory a bank of three 440/110-volt, 25-kva. transformers and a type S 10-kva. Westinghouse voltage regulator have been conveniently mounted in a space 13 ft. (4 m.) long by 40 in. (1 m.) wide, the arrangement shown providing for compact wiring and effective drainage of oil in case of need. The transformers are each set upon two $2\frac{1}{2}$-in. x $2\frac{1}{2}$-in. x $\frac{1}{4}$-in. (6-cm. x 6-cm. x 6-mm.) angle iron

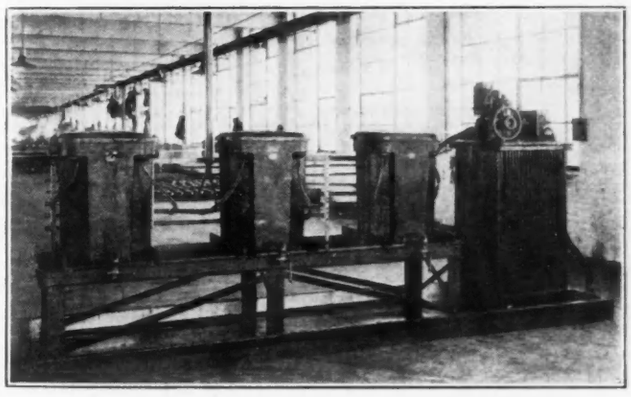


FIG. 1—TRANSFORMER AND REGULATOR MOUNTED IN SMALL SPACE

pieces $20\frac{1}{2}$ in. (50 cm.) apart, the angles being fastened by carriage bolts to two horizontal 4-in. (10-cm.) channels 9 ft. (2.7 m.) long and 28 in. (70 cm.) apart on centers. The channels are carried 24 in. (60 cm.) above the floor level by similar vertical members. Diagonal braces of $\frac{5}{16}$-in. x $1\frac{3}{4}$-in. (8-

mm. x 45-mm.) steel are used. The wiring is carried to the regulator and transformers in 2-in. (5-cm.) conduit, and the open connections are carried at the rear on split porcelain insulators fastened to 1⅛-in. x ¼-in. (28-mm. x 6-mm.) vertical straps with a horizontal tie strap 1½ in. x $\frac{3}{16}$ in. (3.8 cm. x 4.7 mm.) in section. Drainage is effected through 1-in. outlet

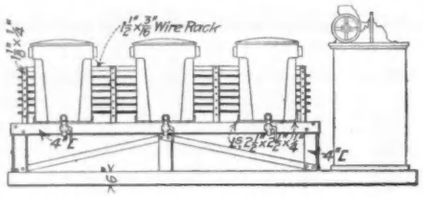
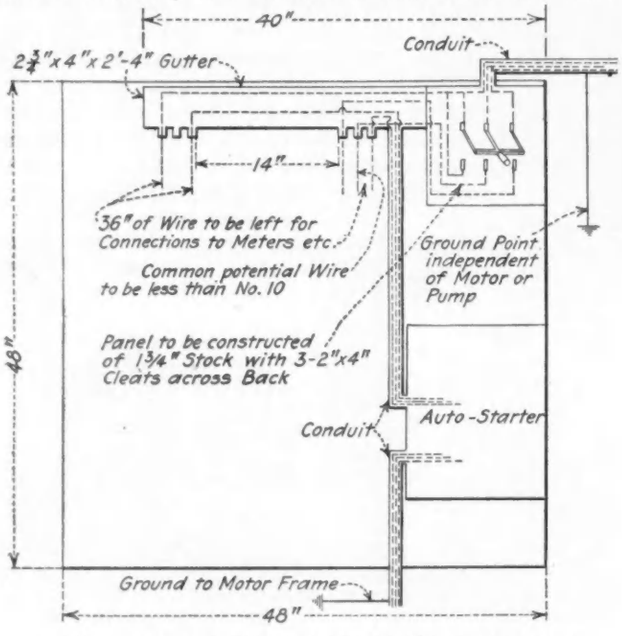


FIG. 2—DETAILS OF TRANSFORMER MOUNTING

pipes screwed into the transformer casings, each being fitted with an elbow and cock at the outer end so that splashing is avoided in emptying the cases. A floor reservoir 6 in. (15 cm.) deep, lined with tin and connected with a trap and sewer drain, is installed below the equipment. Frames and conduit are grounded, and the installation enables good ventilation to be obtained at little cost in space.

Standard Meter Panel Saves Difficulties in Pumping Installation

AFTER considerable difficulty was experienced by the San Joaquin Light & Power Corporation due to unsatisfactory meter panel work in connection with pumping plants for agricultural purposes, it was found necessary to standardize methods of construc-

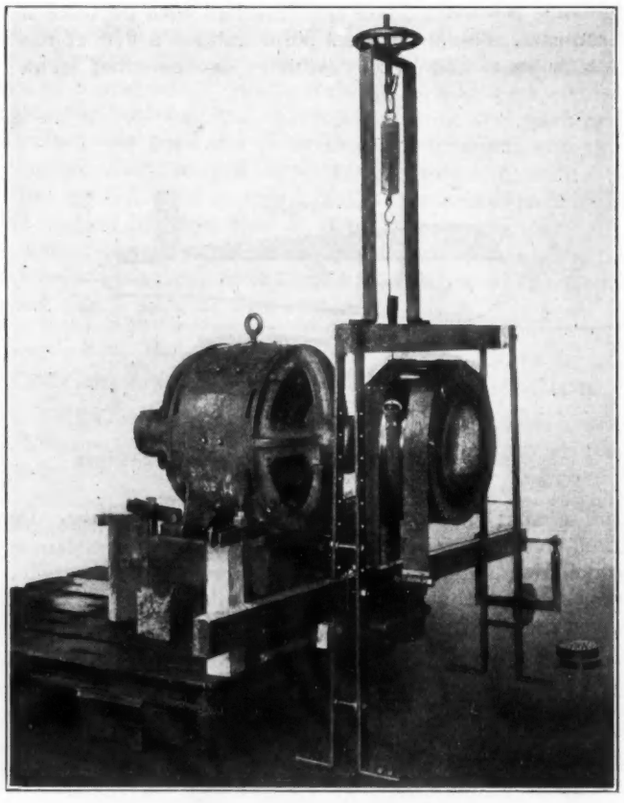

40"
Conduit
2¾"x4"x2'-4" Gutter
14"
36" of Wire to be left for Connections to Meters etc.
Common potential Wire to be less than No. 10
Ground Point independent of Motor or Pump
Panel to be constructed of 1¾" Stock with 3-2"x4" Cleats across Back
48"
Conduit
Auto-Starter
Ground to Motor Frame
48"

METER PANEL FOR PUMPING PLANT 15 HP. OR LARGER

tion. Inferior materials were often used by contractors, and the work was occasionally done in such a makeshift manner that trouble was noticed immediately when the service lines were connected. To avoid constant breakdowns a standard meter panel was designed which complies with all safety regulations. Blue prints of this are furnished to all applying for such service and the company insists that the layout should be used. The resulting satisfaction on the part of consumers more than makes up for the small cost involved in designing this panel and the number of complaints since the adoption of this system has appreciably lessened.

Testing Brake for 100-Hp. Motors

A TESTING brake for motors up to 100 hp. rating built in a New Jersey shop gives very accurate results. In this brake, bands of automobile brake lining pressing on a steel pulley give the braking effect. One end of these bands is attached to a wooden scale beam which is balanced by means of iron weights. There are



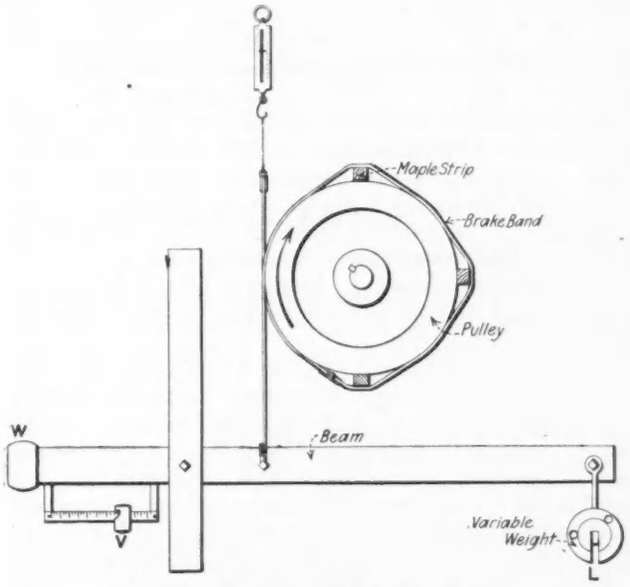
MAKING ACCURATE BRAKE TEST ON 35-HP. MOTOR

two main 4-in. (10-cm.) belts passing up and three-quarters around the pulley, where they are connected to a 2-in. (5-cm.) belt the end of which is fastened by a wire to a small spring scale. The brake lining is of asbestos interwoven with brass or copper wires and stands the heat well. In order to lessen the friction maple-wood strips are inserted between the band and the pulley.

In making a test, after the belt is placed around the pulley the beam is balanced by means of the sliding weight *V*. As the motor is brought up to speed the belt tends to lift the beam. To put different loads on the motor the weight *L* is changed. The beam is so proportioned that 1 lb. at *L* will give a pull of 5 lb. on the belt. The pulley shown has a diameter of 25.2 in. (64 cm.) and a 12-in. (30-cm.) face. With a pulley of this diameter twice the net pull in pounds multiplied by the revolutions per minute and divided by 10,000 gives the horsepower directly. This pulley may be used for any torque up to 300 lb.-ft. (41 kg.-m.). A 12.6-in. (32-cm.) pulley is used for measurements up to a torque of 100 lb.-ft.

(14 kg.-m.). To prevent the pulley overheating it is flanged so that it will hold water during a test.

Care must be taken to prevent the belts jamming around the pulley and tearing loose with possible serious damage. The best results are obtained when the spring



SCHEME OF TESTING BRAKE

balance pull is about one-tenth of the main belt pull. The net pull which is used to calculate brake horsepower is the pull on the main belt minus the pull on the spring scale.

The bearings of the scale beam are carefully lined and are babbitted. The arm is counter-balanced for its own weight and that of the belts and fittings by weights *W* and the sliding weight *V*. The frame must be strong enough to stand an upward pull of 1,000 lb. (450 kg.).

Crocker Wheeler Company,
Ampere, N. J.

F. W. GAY,
Chief Tester.

Rotary Converter Made from 15-Hp. Direct-Current Motor

FOR obtaining alternating current in a Chicago repair shop where only direct current was available a 15-hp., 550-volt direct-current motor was changed over into a rotary converter to give, in conjunction with an auto transformer, 115, 230 and 460 volts alternating current. The motor has four poles and formerly ran 1,200 r.p.m. and was wave-wound with two turns per coil. It was rewound in open-wave style, connecting in parallel the two coils which were of three No. 13 (2.5 sq. mm.) wires each. The fields were changed from all in series to two in parallel, two in series, which on 220 volts gives a speed of about 1,800 r.p.m. As there are 121 bars, alternating-current taps were made at Nos. 1, 41 and 81. The open-wave winding takes less room at the end of the armature than the two-turn coil which it replaced, because the knee formed by the two-turn coil is eliminated and therefore the commutator could be moved closer to the armature and the slip rings mounted on the same end of the shaft. The slip-ring leads were led through the commutator spider and are held in position by a fiber disk between the commutator and the rings.

Both sets of brushes are mounted on the same studs, which are braced at the armature end by a fiber ring, the alternating-current brushes being insulated from the studs while the direct-current leads are attached to them.

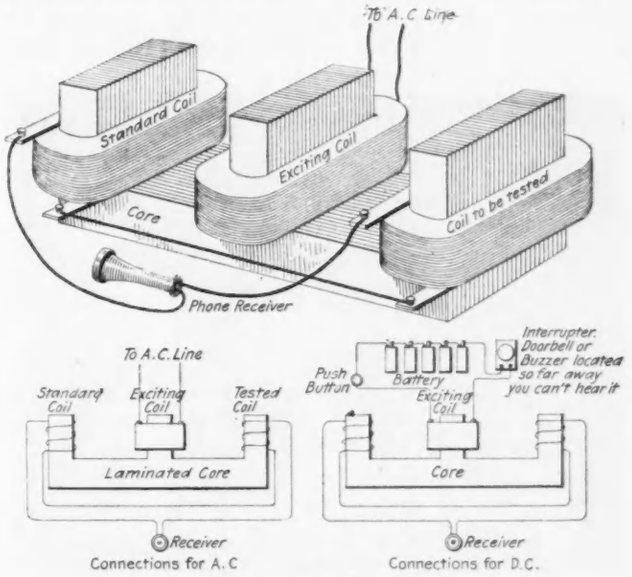
The machine gives 140 volts at 60 cycles, which by an auto transformer is changed to 115, 230 or 460 volts. Approximately 25 cycles may be obtained by paralleling all four fields and operating on 110 volts. Although not connected for the purpose at present, the machine might also be used to drive shop equipment when the alternating-current load is not too heavy.

C. W. GODING.

Chicago, Ill.

Testing Low-Resistance Coils With Telephone Receiver

WHILE overhauling an equipment of series motors in a steel mill a quick and reliable means of testing the field coils for short circuits was desired. For this purpose a method which proved quick and accurate employed a telephone receiver to detect any difference in the induced currents in the tested coil and a coil which was known to be good. For inducing the current in the coils a laminated-iron core shaped like a letter E taken from an old transformer was used. Over one end of this core was placed the good coil, and the coil to be tested was placed over the other end leg. These two coils and the telephone receiver were connected in series in such a way that the voltages in the coils induced by an exciting coil on the middle leg were in opposition. When the exciting coil is energized, if the coil under test is not short-circuited, the voltage induced in it balances that of the good coil and the telephone receiver is quiet. If there are any short-circuited turns, the voltages will not balance and a buzz will be heard in the telephone. The exciting current in the middle coil



BAD COIL CAUSES A BUZZ

may be furnished from a 110-volt alternating circuit or, when no alternating-current supply is available, by direct current interrupted by a common doorbell or buzzer. If the 110-volt alternating current is used, the exciting coil must have sufficient resistance to prevent heating, while a coil used with an interrupted dry battery current need not have a high resistance.

Cleveland, Ohio. JAMES DIXON.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Interrelation of Revenue from Washing Machines and Irons

THE washing machine, which in itself is one of the poorest producers of central-station revenue, indirectly causes a very appreciable increase in customers' bills because of its relation to the electric flatiron. This is the experience of Robert Montgomery, commercial manager of the Louisville (Ky.) Gas & Electric Company, as given in a paper read before the commercial section of the Indiana Electric Light Association. He said that an electric washing machine insures the weekly washing being done at home, with the result that the electric iron is put to work. In this manner the electric iron is made to produce a revenue of about $12 per year, whereas without the machine the washing is often sent out, and in that event the flatiron produces virtually no revenue.

Utica (N. Y.) Company Maintains Contractor-Dealer Window Display

BY W. J. REAGAN
Commercial Manager Utica Gas & Electric Company

THE Utica Gas & Electric Company of Utica, N. Y., has adopted a unique method of handling window displays. This company does not merchandise domestic appliances but has advanced ideas with reference to co-operation with the local contractor-dealers. The office

TYPICAL WINDOW DISPLAY WHICH HAS ESTABLISHED CENTRAL-STATION AND CONTRACTOR-DEALER CO-OPERATION

windows are fitted with a handsome valance and draw curtains, made of poplin, lined and embroidered. These completely screen the windows while the displays are being arranged and present a draped effect from the sides when opened. The window floors are covered with rich Wilton carpet and inclosed in the rear with a quartered-oak barrier standing 5 ft. (1.5 m.) from the floor. Pedestals of varying heights, card holders and decorative fabrics are included in the equipment. The company has secured the services of a decorator from a leading department store to work on a part-time basis and arrange the displays. One-half of the decorator's time is paid for by the company and the remainder by the exhibitor.

Membership in the local section of the National Electric Contractor-Dealers' Association extends to each dealer the privilege of exhibiting for two weeks in the utility company's windows. The members' firm names are listed alphabetically, and when the turn of each approaches the decorator notifies the firm, learns the particular feature it wishes to display, and on the arrival of the stock at the utility company's office arranges the exhibit. This method simplifies the matter for the contractor, and incidentally the company can maintain the standard of all displays. Six general campaigns are arranged throughout the year in which all members participate. Special apparatus is featured singly—washing machines, vacuum cleaners, electric irons, fans, etc.

Dealers who desire may have demonstrators on the office floor during these special sales efforts. W. J. Reagan, commercial manager of the Utica Gas & Electric Company, states that the results have shown that these specific drives are very remunerative to all who participate. Membership in the association is not confined strictly to contractor-dealers. Local department stores sustain connection as associate members. The accompanying illustration shows a window display which is typical of those used by the company. A card giving the name of the local contractor-dealer is shown in the window at the left.

Profiting from the Gas Man's Experience

IN A paper presented before a group meeting held under the auspices of the publicity committee of the New England Section of the National Electric Light Association at Augusta, Me., M. C. Osborn, in discussing the heating of water electrically as a problem associated with the installation of electric ranges, dwelt on the early experience of gas companies, which he thought afforded valuable hints of what to avoid.

When, about thirty years ago, the gas man invented the phrase "Cook with gas," said Mr. Osborn, he rushed frantically about extending mains, putting in pipes and services and installing appliances free of charge. He reduced his rate on gas used for fuel, installing another meter with this in view. The gas stoves were auxiliary to the coal or wood ranges, and no attempt at water heating was made. It was soon found that such a policy

spelled financial ruin, and it was not until the all-gas kitchen appeared, simultaneously with the placing of gas water heaters on the market, that a profitable business was developed. The extra meter then disappeared—often the coal or wood range went with it—and all gas consumed was charged for at the same rate.

Here, maintained Mr. Osborn, is a hint for the central station bent on installing electric ranges. Why not begin with the all-electric kitchen, including a water-heating device, instead of coming to it by degrees after the unprofitable manner of the gas man?

Growth of Illinois Company Demands More Facilities

THE Public Service Company of Northern Illinois, which serves fifteen counties of that state, reports that there is every prospect during 1920 of exceeding last year's record in wiring old houses. That record was over 3,000. It is pointed out that many of the houses to be wired this year will use electricity for power in addition to lighting, for they will install electric ranges and household devices. Plans are also being laid for more store, factory and ornamental lighting. The power business of the company has been greatly increased by an important industrial region created in a belt around Chicago beginning at Waukegan on the south and extending through towns west of Oak Park to South Chicago, Harvey, Joliet and down to Kankakee and Streator.

Gee!—now I'm a business man
YOUR boy—every boy—wants to grow up to be a business man of power and influence in the community. Ten or twenty years from now the boys and girls of today will be our most influential citizens—doing the work now on the shoulders of their fathers and mothers.
Give your boy or your girl a share of the Preferred Stock which we are now offering to customers and employes on payments of only $5.00 a month, so that now—in his youth—he may have the kind of financial and business training that will better prepare him for success later on.
Have Your Boy Make the Payments
$5.00 Down—$5.00 Per Month
as they come due every month. Give him the money, but let him handle the matter himself, getting the receipts and keeping them. He'll learn something of business this way—he'll learn what securities are—what dividends are—he'll take a personal interest in saving and investments. In later years this knowledge will be to his decided advantage to him.
An Investment of Assured Safety
When you buy stock in the Public Service Company of Northern Illinois you know your investment is safe—it is your own home utility company—here for all the time, helping to develop the community—helping add to its prosperity. When your boys and girls have grown to manhood and womanhood the Public Service Company will serve them—and their children—just as it now serving you.
Buy a share of this safe, dependable stock for every member of your family on the easy terms now available to you. Not more than five shares, however, will be allotted to any one person on this easy payment plan.
Dividends at the rate of $6.00 per share will be paid on this stock from date of purchase. Price $100 per share as fixed by the Illinois Public Utilities Commission.
Inquiry Coupon
Give your boy or girl the right start. Act now. Call at our local office or at your bank for details.
Public Service Company of Northern Illinois

INVESTMENT APPEAL TO CUSTOMERS IN ADVERTISING STOCK-SELLING CAMPAIGN

The company's big electric station at Joliet, which now contains two units of 10,000 hp. each, is urgently in need of another unit of the same size. The Waukegan station requires a large increase in its capacity. New transmission lines are also needed to improve and amplify the company's distribution facilities. New transformer stations are also needed.

In the construction of these improvements new capital is required. This is being raised by a stock-selling campaign among customers of the company in which employees act as the salesmen. A typical advertisement used—one which appeals to the thrift instinct of the small purchaser—is shown in the accompanying illustration.

Wholesale Rate Making for Energy to Be Sold at Retail

Ideal Is That Purchasing Company Can Afford to Resell at Rates It Would Charge if Both Companies Were Under One Ownership

BY KASANDRA

THERE are two theories of prices. One is that price should be based on the costs that did occur, and this theory involves allocation of all the joint costs. The other theory is that price should be based on what the lowest costs would be if the same service was performed in some other way, as by a competitor.

In many cases both theories lead to the same result. For instance, a shoe manufacturer may base his prices on his own costs, but his own costs are apt to be the same as his competitor's costs; hence his prices come out the same whether he bases his prices on his own costs or on his competitors' costs.

When an electric utility makes the energy itself the various schemes for allocation of costs have been worked out by trial and error to give prices that are just enough lower than what it would cost the customer to get the equivalent service in some other way to insure that the customer will take the utility service rather than the competing service. The competing service may be an isolated plant, or gas, or oil, or sunlight (which is paid for in the form of rent), or the competing service may often be central-station energy in another town to which the customer can move.

When energy is made the allocation of the costs depends on the accounting system, but when energy is purchased and resold it is obvious that the allocation of the wholesale cost to the retail business depends on the form of the rate on which the purchase is made.

In figuring on the purchase of power two cases occur. First is the question of the existing business, and as regards this the only problem is the total bill or dollars paid for the purchased energy compared with what it would cost the utility to make the same amount of energy itself. If the utility can save money by purchasing, it should do so whatever the form of the rate.

If the utility uses 1,000,000 kw.-hr., costing to make $25,000, and can buy for $24,000, it makes no difference at the start whether the form of the rate is a monthly bill of $2,000 or a rate of 2.4 cents per kilowatt-hour or a block rate of 5 cents, 4, 3, 2 and 1 cent, making $24,000 for the 1,000,000 kw.-hr. The rate may even be a demand rate working out to $24,000 a year. At the start it makes no difference, but when the amount of service changes then there is a difference. A company making its own energy at an expense for interest and coal must consider how any new business will affect these costs, while a utility purchasing energy must consider how the new business will affect its power bill.

The same thing would be true if we compared water power and steam power. A water-power company finds that various kinds of new business will affect its costs in a very different way from the way in which they would affect the costs of a steam-power company.

Now, for ordinary small business the form of rates is the same whether the energy be purchased or made by steam or by water power. This is because in ordinary cases the prices are either based on what it would cost the customer for the competitive service or, if

the prices are based on an allocation of past costs, the allocation has been worked out by trial and error to give the same results.

There are, however, cases where the prices that the customers can afford to pay are so low or when the effect of the customers' use on the costs is so high that the question of the sellers' costs must be considered, and a steam plant must often refuse business that a water-power plant can afford to take. Some chemical business and some water-heating business are instances. Vice versa, a steam-power plant can afford to take a certain business of a very poor load factor which a straight water-power company could not afford to handle.

If, instead of comparing steam power and water power, we consider purchased energy, we see that the form of the rate may have the same effect as the difference between water power and steam. A company purchasing on a straight kilowatt-hour rate cannot afford to take any business at less than the kilowatt-hour rate at which it purchases, but it can afford to take some business of very poor load factor which it could not handle if it made its own power. Vice versa, if the power is purchased on a demand rate of so much per kilowatt of demand and no kilowatt-hour charge the purchasing company can afford to resell at very low rates for business of good load factor but may not be able to afford to take on some business of low load factor, even though it could take on such business if it made its own energy.

The lesson is that the form of rate for the purchased energy may and often will affect the growth of the company that purchases. In turn this will affect the costs and profits of the selling company by reason of decreasing or increasing its sales. It follows that the ideal form of rate is such that the purchasing company can afford to resell at exactly the same prices that would be charged if both companies were under one ownership.

Some companies have this ideal in mind, as, for instance, when they make the rates for the bulk supply to a large apartment house such that the owner can just get paid for his metering and other expenses if he buys wholesale and retails to his tenants at the same price that the tenant would pay if he bought direct at the central-station retail rates.

When the form of the rate is not such as to attain this end, then the only thing to be done is for the selling and purchasing companies to keep in close touch, and if the form of the rates is such as to interfere with the development of any business that would be profitable in case the two companies were under one ownership, then the thing to do is to change the rate, either directly or by some special provision affecting only the special new business, so that the public shall get the maximum service and neither the selling nor the purchasing company shall lose thereby.

Some Advantages of Using Colored Bills

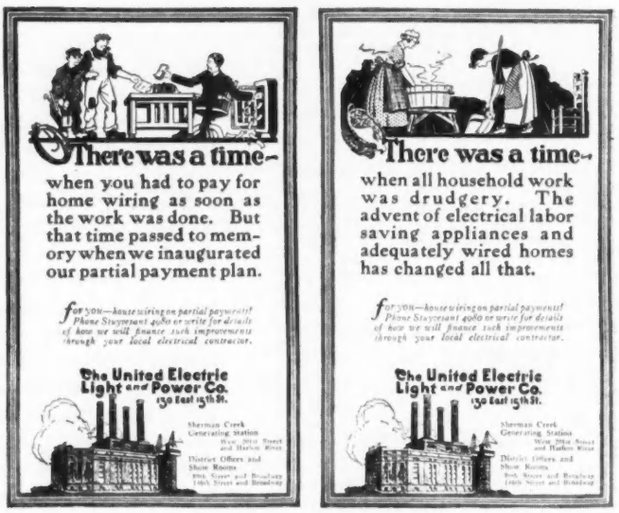
THE Springfield (Mo.) Gas & Electric Company has three bill-paying periods during the month and finds it desirable to use bills with a distinctive color for each period. Bills read between the twenty-seventh of one month and the fifth of the next are all delivered by the meter readers on about the tenth and the customers are given from the tenth to the twentieth to make payment. All bills due during this period are of a buff color; those due between the twentieth and the thirtieth are melon-colored, and bills payable between the first and tenth are white. This makes it easy for the company clerks and for collection agencies to tell at a glance whether or not a bill is paid on time.

The company makes a practice of delivering its bills, but finds it desirable to send some bills through the mails. For this reason colors were chosen from among those approved for mailing purposes by the postal authorities.

Nine-Week House-Wiring Campaign in New York City

ON MARCH 15 the United Electric Light & Power Company started, through advertisements in the newspapers of New York City, a house-wiring campaign which will be conducted during the spring months. Through the adoption of a partial-payment policy and an offer to help local contractors finance the work the co-operation of the electrical contractors in the districts which are served by the company has been wholeheartedly secured.

For nine weeks the company plans to use uninterruptedly in every New York newspaper advertisements such as are shown below. During seven weeks of this


There was a time—
when you had to pay for home wiring as soon as the work was done. But that time passed to memory when we inaugurated our partial payment plan.
for you—house wiring on partial payments!
The United Electric Light and Power Co.
130 East 15th St.
There was a time—
when all household work was drudgery. The advent of electrical labor saving appliances and adequately wired homes has changed all that.
for you—house wiring on partial payments!
The United Electric Light and Power Co.
130 East 15th St.

TWO OF THE TWENTY-SEVEN ADVERTISEMENTS THAT WILL APPEAR DAILY IN NEW YORK CITY NEWSPAPERS DURING MARCH, APRIL AND MAY

period the advertisements will appear in morning newspapers. Both morning and evening newspapers will, however, be used during the last two weeks. Twenty-seven separate pieces of advertising copy will be employed.

A survey has been made of all unwired houses in the districts served by the United company, and after the advertisements have appeared for two weeks, form letters will be addressed to these prospective customers for house wiring, calling attention to the house-wiring campaign and its partial-payment feature. Form letters are also being sent to local contractors who might be interested in executing some of the contracts received.

The campaign is being conducted by Ralph Neumuller, advertising manager of the United Electric Light & Power Company.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

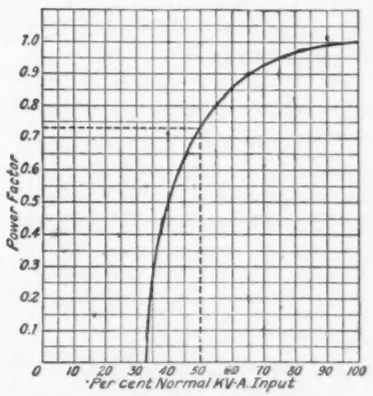
Unbalanced Magnetic Pull in Electric Machines.—TH. LEHMANN.—The Maxwell formula for magnetic pull holds only for cases where the pole surfaces are smooth. If applied in the computation of unbalanced pull in machines with salient poles or open slots, it will often give values which are 50 per cent too small, owing to the neglect of the non-homogeneity of flux. By considering energy stored in the magnetic field the author has obtained an equation for the pull in this more general case. He finds that the Maxwell expression $\phi 2/8\pi$ should be multiplied by $\delta R/\delta l$, the partial derivative of air-gap reluctance with respect to a rotor displacement. This relation holds also in case of armature reaction and is independent of saturation. Numerous examples are worked out algebraically and numerically, showing the application of the new formula to various kinds of machinery.—*Revue Général d'Electricité,* Nov. 29 and Dec. 6, 1919.

Parallel Operation and Synchronizing of Frequency Converters.—O. E. SHIRLEY.—The operation of a single-frequency converter between two systems is comparatively simple. However, when more than one converter is used the phase angle between the incoming generator and the bus introduces a factor which must be provided for. The author gives a clear explanation of the reasons for this phase displacement between loaded and unloaded converters tying in the same systems. In modern frequency-converter sets the difficulty introduced by this condition is taken care of by means of a motor-operated screw which shifts the stator of the motor or generator in its cradle to the required position.—*General Electric Review,* February, 1920.

Some Mechanical Features of Synchronous Machines.—A. P. WOOD.—A description of the mechanical features of the present-day design of synchronous machines. Illustrations are given of the improvements which have been made in design and construction by the introduction of arc welding and spot welding. The oil starting system and the oil circulating system are described, as well as the coreless and cored-box type of stator frame and the rotor spiders of various types and speeds.—*General Electric Review,* February, 1920.

Oscillating Frequency of Two Dissimilar Synchronous Machines.—R. E. DOHERTY.—In operating two or more alternating-current generators driven by reciprocating engines it is important to avoid a condition that will produce "hunting" or a periodic oscillation of the revolving elements ahead of and behind the normal position. In cases where the normal oscillating frequency of the alternator is near the periodic variation in the torque of the driving engine, hunting may occur in such proportion as to throw the generators out of phase or produce violent flickering of lamps or other trouble on the circuit. In a previous article published on this subject the author has discussed parallel operation of similar alternators with respect to hunting, and in the present article he extends the discussion to parallel operation of two dissimilar alternators.—*General Electric Review,* February, 1920.

Synchronous Motors.—W. T. BERKSHIRE.—The judicious employment of synchronous motors in combination with induction motors will correct the fault of low power factor and thereby result to the advantage of the distributing company as well as the user of the motor.



POWER-FACTOR CORRECTION OF SYNCHRONOUS MOTORS AT PARTIAL LOADS

The usefulness of the synchronous motor in correcting power factor is strikingly shown in the illustration. The curve shows the leading power factor at which a normally designed unity power-factor motor will operate at partial load with normal full-load field excitation.—*General Electric Review,* February, 1920.

Lamps and Lighting

Lighting for Country Homes and Village Communities—WILLIAM KUNERTH.—The writer sets forth the advantages of electric lighting for this purpose and gives a table of comparative costs of lighting per year by various means, ranging from the candle to the gas-filled incandescent lamp.—*Bulletin* 55, *Engineering Experiment Station, Iowa State College,* Oct. 8, 1919.

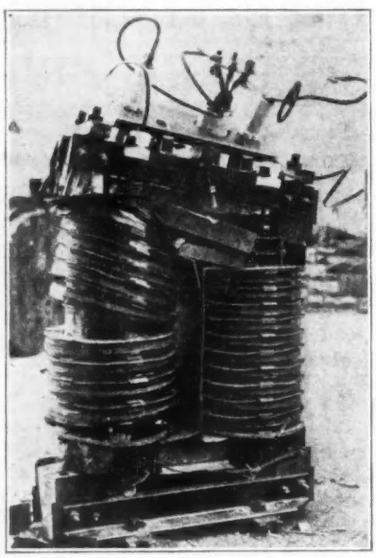
Generation, Transmission and Distribution

Occurrence of Overvoltages at Points of Discontinuity on Transmission Lines.—GRABSCHEID.—Discontinuous changes in the electric constants of transmission lines may cause considerable overvoltages when surges pass along the lines. Such discontinuities may be due to a change in conductor diameter or in the distance to ground, or they may be due to the branching off of lines which are carried on the same poles for some distance. In connection with a theoretical discussion of this problem some numerical examples are worked out to show the order of magnitude of the effect. The author questions whether the abnormal number of insulator failures observed on a high-tension line in the neighborhood of Trieste could not be explained by overvoltages

due to abrupt changes in the distance to ground. In these parts the ground contains huge masses of rock interspaced by regions of moist earth, and the effective distance from conductor to ground must therefore be subject to large and sudden variations from place to place. The seriousness of the situation is indicated by the fact that the transmission voltage had to be lowered from 50 kv. to 25 kv. in order to cut the rate of failures to normal proportions.—*Elektrotechnik und Maschinenbau*, June 29, 1919.

Four-Day Test on Five Boilers Burning Pulverized Coal.—A complete report and analysis of a four-day test on five boilers in the Oneida Street plant, Milwaukee, under average operating conditions in which comparisons were made with underfeed stoker operation. Under test conditions the efficiency of burning is only a trifle higher than with a modern-type stoker, but in daily operation the elimination of the many valuable conditions entering into stoker operation, the flexibility and ease of control and other advantages are reported in favor of powdered coal to offset the higher cost of fuel preparation.—*Power*, March 2, 1920.

Effects of Short Circuits on Power-House Equipment.—E. G. MERRICK—The widespread tendency toward the interconnection of power systems and the development of generating stations of great capacity have created grave problems in properly handling the



TRANSFORMER TESTED TO POINT OF MECHANICAL FAILURE UNDER SHORT-CIRCUIT CONDITIONS

vast amounts of energy which can be concentrated in a single fault. The author deals particularly with the electromagnetic stresses and abnormal temperatures developed in power-house equipment resulting from short circuit.—*General Electric Review*, November, 1919.

Protection of Alternating-Current Systems.—KENELM EDGCUMBE.—The points which the author brings out may be summarized as follows: (1) In any scheme of protection continuity of supply should be the first consideration, simplicity the second and adaptability the third. (2) The neutral points of generators and step-up or step-down transformers should be earthed through a resistance having a negative temperature co-efficient. (3) When the neutral point is not available the system can be earthed through a zigzag transformer and an earthing resistance. (4) In a large number of cases special conductors are out of the question and any and every part of a distribution system can be protected by overload, reverse or leakage relays in accordance with the various methods discussed in the paper. (5) All overload relays must have similar time-current curves with a definite minimum, independent of the overload. (6) All reverse relays must be compensated for a fall of voltage down to 2 or 3 per cent and may in some cases be required to operate with a heavy current in either direction at zero voltage. (7) Current transformers should be of the straight-through type whenever possible, and should otherwise be protected by a non-inductive shunt of ample current-carrying capacity and specially adjusted to the transformer characteristics.—London *Engineer*, Feb. 20, 1920.

Traction

The Calculation of Track Pressure Drop and Losses on Direct-Current Electric Railways.—F. F. P. BISACRE.—In the design of an electric railway two important considerations are the pressure regulation of the distribution system between the trains and substations (track circuit) and the losses of energy therein. On these two questions the main features of the electrical layout of the distribution system hinge. The author states that there is little, if any, information published on the mathematical side of these questions. He then proceeds to make a mathematical analysis of the problems.—London *Electrician*, Feb. 20 and 27, 1920.

Electrification of the Turin-Cirie-Lanzo Railway.—This railway, which is a steam line, is being transformed into an electric one. The system adopted is the direct current one at 4,000 volts. The hydro-electric generating station at Funghera supplies 50-cycle, 40,000-volt, three-phase current to a single transformer station in Cirie, about half-way between Turin and Lanzo. In this substation are installed two 650-kw. groups, each consisting of transformer, synchronous motor and dynamo. The transformers step down the pressure to 500 volts. Special devices are used to avoid flash-overs in the dynamos. The locomotives serve also as baggage cars. They have four axles and four motors, each of 110 kw. at 1,800 volts, so that they are permanently connected two in series. The transmission from the motors to the axles is obtained through gears of the ratio 1 : 3 : 95. The locomotives can develop a tractive effort of 9,300 kg. when starting and 4,650 kg. when running. The speed can vary between 31 km. and 65 km. per hour. The maximum weight of a passenger train will be 150 tons and that of a freight train 250 tons. The trolleys are pneumatically controlled, and the aërial wires are longitudinally supported by steel ropes. The distance between poles does not exceed 50 m.—*Science Abstracts, Section B*, Aug. 30, 1919 (Abstracted from *Elettrotecnica*, June 5, 1919).

Electrophysics and Magnetism

Magnetic Testing of Straight Rods in Intense Fields.—W. L. CHENEY.—Previous experiments at high inductions are discussed. A method which is suitable for measuring the magnetic properties of fairly long rods of ferromagnetic materials, when magnetized in intense fields, is described. Normal induction data are compared with those obtained by the Burrows method and found to agree satisfactorily within the range of

the latter. From the normal induction data the intensity of magnetization and reductivity are calculated and discussed.—*Scientific Paper No. 361, U. S. Bureau of Standards*, Feb. 21, 1920.

Magnetic Mechanical Analysis of Cast Iron.—S. R. WILLIAMS.—The author calls attention to the results obtained by Rood (ELECTRICAL WORLD, Jan. 13, 1917) in which the conclusion was reached that cast iron does not have its permeability affected by tension. In the results of experiments reported in this paper the author comes to the conclusion that it has been shown that cast-iron rods, whose chemical compositions are given, have their permeabilities changed by tension.—*Proceedings American Society for Testing Materials, Part 2*, 1919.

Voltage Distribution Over a Condenser-Chain.—A. SCHWAIGER.—Owing to the capacity of the insulator units, the voltage distribution over a chain insulator is not even, but the unit close to the line will sustain a greater part of the line voltage than the next one, and so on, the distribution of voltage following a hyperbolic sine law. Experimental results by the author substantiate this theory. Measurements of breakdown voltage of a transformer, consisting of a number of insulated coils on a rectangular core, show that a similar law holds also for this case. The measurements were made at comparatively low voltages by means of a very small spark gap. If the capacity of a certain coil in the transformer shows a marked difference from the average, a sudden steep jump may occur in the voltage distribution curve. This suggests a reason for certain inexplicable breakdowns between coils in the middle of a transformer.—*Archiv für Elektrotechnik*, Oct. 10, 1919.

Electrochemistry and Batteries

Care of Storage-Battery Locomotives.—HUMPHREY D. SMITH.—A practical discussion of the care that should be given storage-battery locomotives used for coal mining. The modified constant-potential method of charging is recommended, and it is stated that the "constant potential" method has the disadvantages of high initial peak and that the voltage must be increased toward the end of the charge unless the charging is to be unprofitably slow, In order to prevent excessive gassing the temperature rise should not be too great. With the Edison battery, however, the charging rate should not be too slow, since it will reduce the speed and mileage of the locomotive on the discharge that follows. Many suggestions are given to the crews operating the locomotive and to those in charge of the electrical systems of the mines in order to get the best results from the batteries.—*Coal Age*, Feb. 5, 1920.

Estimation of Nitrates and Nitrites in Battery Acid.—L. B. SEFTON.—Three methods for the determination of nitrates, the diphenylamine, and hydrostrychnique and the brucine, were studied with reference to their use in testing storage-battery acid. It was found that nitrates in dilute acid could not be estimated in the presence of nitrites, but that by means of either the hydrostrychnique or the brucine method nitrates and nitrites could be estimated together. In the absence of iron, either the hydrostrychnique or a modification of the brucine method is recommended for the determination of nitrates and nitrites.—*Technologi... Paper No. 149, U. S. Bureau of Standards*, Feb. 24, 1920.

Units, Measurements and Instruments

Potentiometric Amplifier Connections.—BLONDEL and TOULY.—In a previous article one of the authors has described various arrangements where thermionic amplifiers are used for the measurement of minute emfs. In the present paper some of the latest refinements in this field are dealt with. The principle of these amplifier systems is briefly as follows: A three-electrode vacuum tube, with its auxiliary batteries and resistances, is built into a Wheatstone bridge. At a balance no potential difference will exist between two corners of the bridge which are connected to the filament and grid of a second tube. However, if by impressing a small emf. on the grid of the first tube the current distribution over the arms of the bridge is changed, a voltage will be impressed on the grid of the second tube. Instead of a Wheatstone bridge various potentiometric arrangements have been used with good results. When two or more tubes are used regenerative action may also be obtained, by use of suitable back-coupling resistances. With only two tubes in regenerative coupling and three batteries, any desired voltage amplification may be obtained. For the direct measurement of small alternating emfs. with direct-current galvanometers a third tube is added, which acts as a rectifier.—*Revue Général d'Electricité*, Oct. 4, 1919.

An Improved Weir for Gaging in Open Channels.—CLEMENS HERSCHEL.—The author describes a new weir which indicates that for discharges from 0 cu.ft. to 9.55 cu.ft. per second per foot (0.08 cu.m. per sec. per m.) of weir length, the limits covered by the experiments, the quantity of water flowing, Q, was directly proportional to the difference, d, in two pressures, one measured just upstream of the weir (corrected automatically for the velocity of approach) and the other measured at the crest, the formula being Q 5.50 d.. The paper contains descriptions and diagrams of the apparatus and tests of the new weir.—*Mechanical Engineering*, February, 1920.

Telegraphy, Telephony and Signals

An Experiment on Impulse Excitation.—JOHN H. MORECROFT.—A description of an oscillographic investigation of the current produced in an oscillatory circuit by a brief rectangular pulse of emf. directly introduced into the circuit. The pulse length is regulable. It is found that a pulse having a duration of one-half the natural period of the circuit produces the maximum disturbance. The bearing of the results on the effects of strays in reception is discussed. The behavior of "infinite impedance" loop circuits when subjected to pulse excitation is studied, and it is found that for pulses their filtering action is much reduced.—*Proceedings Institute of Radio Engineers*, February, 1920.

The New Marconi Distress Calling Device.—Where there is only one radio operator on shipboard, as is commonly the case, he cannot listen for twenty-four hours of the day on the chance of hearing a distress call. The problem thus caused was attacked by the research laboratory of the Marconi Wireless Telegraph Company with the idea of ringing a bell by means of wireless telegraphy, and a relay has been devised which will respond only to the predetermined distress signal. As long as the distress signal is being received the alarm bell will ring.—*Wireless World*, March, 1920.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

INSISTENT increased demand for electrical supplies during the past week is apparent in all sections of the country, with the activity most pronounced in New England and in the Southern states. Shipments are only slightly improved, but nevertheless contain enough building materials to keep construction going, although contractors have great difficulty in obtaining material, which is being doled out by jobbers on a piecemeal basis.

A GENERAL lengthening of collections has been noticed throughout the country because of the shortage of cash and high interest rates.

MALLEABLE iron is scarce and electrical manufacturers are put to it to continue deliveries. Substitutes are being introduced.

INCANDESCENT lamps have advanced in price, the increase amounting to from 5 cents to 15 cents on the list price. The advances are more pronounced on the frosted bulbs. Reductions, however, have been applied to the larger type C lamps. Further advances have been made on certain types of push-button switches.

HEAVY export orders have been placed this week for suspension-type insulators.

ACCRUED depreciation may be taken into consideration in making rates in cases where dividends have not been excessive and no adequate depreciation fund has been maintained, according to the New York Public Service Commission, Second District.

NORFOLK, Va., has officially adopted a policy of financial encouragement to public utilities, based on business agreements and an adequate rate of return.

THAT a customer of an electric supply company cannot be denied service because of his refusal to pay the fee necessary to obtain a certificate of approval from the Board of Fire Underwriters is the finding of the New York State Court of Appeals on the third trial of a suit for damages against the New York Edison Company.

A CONTRACT between the Eastern Pennsylvania Light, Heat & Power Company of Pottsville and the Metropolitan Edison Company of Reading for interconnection makes a total of three interconnection schemes entered into by the former company, the others being with the Lehigh Navigation Electric Company at Tamaqua and the Schuylkill Gas & Electric Company at Frackville.

REPRESENTATIVES of the state organizations of Wisconsin, Illinois, Indiana and Michigan have agreed to recommend to their respective bodies the formation of a Great Lakes geographic section of the N. E. L. A., to include these four states, as suggested by national headquarters.

FORMAL organization of the International Chamber of Commerce is to take place at Paris during the week of June 21.

THOMAS N. MCCARTER, president of the Public Service Corporation of New Jersey, declares that the commissions should speed up their decisions, in view of prevailing conditions.

PROF. ELIHU THOMSON has accepted appointment as acting president of the Massachusetts Institute of Technology, pending the election of a permanent head.

OPERATING voltage on the Ellsworth-Veazie transmission line of the Bar Harbor & Union River Power Company, connecting with Bangor, Me., has been raised to 50,000 volts to handle increasing loads.

ABOUT $750,000 worth of group life and disability insurance for its 600 employees has been taken out by the Hartford (Conn.) Electric Light Company.

INCREASED coal costs due to the 27 per cent raise in miners' wages will result in a 15 per cent increase in the cost of producing electrical energy, and an increase in rates will be the natural result, according to M. H. Aylesworth, executive manager of the National Electric Light Association.

DEVELOPMENT of the Moore lamp to the point where it can be operated from 220-volt circuits without the use of an auxiliary starting device was announced by D. McFarlan Moore before a meeting of the New York Section, A. I. E. E.

MORE than 2,000 members have been added to the N. E. L. A. since last November through the membership committee of its Pacific Coast Section.

CHAIRMAN JACKSON of the Wisconsin Railroad Commission and Chairman Edgerton of the California Railroad Commission, who are to address the Pasadena convention of the N. E. L. A., will be the first commission chairmen who have ever appeared before that body.

RURAL rates, valuations and automatic substations were discussed in the second day's sessions of the Wisconsin Electrical Association. W. C. Lounsbury was re-elected president.

THIRTEEN public utility companies borrowed a total of $34,562,940 in March on securities to yield between 7 and 8 per cent interest. Two ten-year bond issues, amounting to $8,503,000 are included in these figures.

H. L. CLARK, vice-president of E. W. Clark & Company, Philadelphia, urges that public utilities be allowed to earn 9 per cent.

BONDS to the amount of $25,000,000 are being issued by the Western Electric Company to bear 7 per cent interest and mature in five years.

INSTALLATION of automatic telephones in New York City is to be begun at once.

W. L. GOODWIN and S. A. Chase report much enthusiasm in the Southern cities they have visited in the interests of electrical co-operation.

MUCH optimism concerning the outlook for electrical utilities was expressed by Joseph B. McCall at a meeting of the Pennsylvania Electric Association.

AFTER an extended session the Congressional conferees on the water-power bill report "no progress," and the opinion is expressed by some in Washington that considerable time will be necessary to work out a compromise.

JAMES D. MORTIMER has resigned as president of the North American Company, effective Nov. 1.

COMPARATIVELY little damage to central stations in the West and South is reported as a result of the tornado on Sunday last.

SALES of $230,000,000 for 1919 are shown by the annual report of the General Electric Company, or about $3,000,000 more than in 1918.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

Little Damage to Central Stations in Palm Sunday Tornado

COMPARATIVELY small damage to electric lighting systems was done by the tornado that swept over northeastern Illinois, northern Indiana, part of Ohio, Missouri and Wisconsin, west central Georgia and Alabama on Sunday, March 28. Wires and poles were down in the devastated regions, and electric light in some places was not available for forty-eight hours. Owing to the extensive damage to the telephone and telegraph systems little detailed information was available up to the time of going to press.

It was reported that the Elgin electric light plant (probably referring to the 720-kw. plant of the Elgin Merchants' Light Company) was wrecked. The storm was probably more severe in Elgin, Ill., than anywhere else. The expense of the storm to central stations in Chicago and the vicinity it is reported will be more than $25,000.

In the South considerable damage was done to the hydro-electric distributing system of the Columbus, (Ga.) Power Company between Newnan and Lagrange and between Lagrange and West Point. The Columbus Power Company reports a loss of more than twenty high-tension towers in this section. The retail distribution in the towns of Lagrange and West Point was so badly damaged as to prevent a resumption of service before Tuesday night. So far as can be ascertained, there was no damage by high water or storm to substations, hydro-electric plants or street-railway property.

State Commissioners to Address N.E.L.A. Convention for First Time

FOR the first time in the history of the National Electric Light Association, members of state regulatory bodies will address its convention, according to a statement issued from headquarters of the association this week. Chairman Carl Jackson of the Wisconsin Railroad Commission will read a paper on "The Trend of Regulation" and E. O. Edgerton, chairman of the California Railroad Commission, will speak on "The Reward of Efficiency."

G. E. Annual Report Shows 1919 Sales of $230,000,000

WHILE for some months after the armistice sales by the General Electric Company were curtailed, during the last eight months of 1919 orders increased steadily and rapidly, so that present demand is greatly in excess of the capacity of the company's factories, it is stated in the annual report of the General Electric Company for 1919. Orders amounting to $237,623,932 were received, or about $3,000,000 more than in 1918. Unfilled orders at the end of the year amounted to $98,880,000, compared with $80,000,000 at the end of 1918. Sales billed in 1919 amounted to $229,979,983, or $13,164,706 in excess of 1918.

The company is adding substantially to its manufacturing capacity by enlarging its present plants and in part by purchasing, or leasing with option to purchase, factories already constructed which offer immediate available facilities.

For additional land, buildings, machinery and other equipment there was expended during 1919, $14,462,286. Total factory floor space amounted to 20,681,000 sq.ft., which was an increase over 1918 of about 1,000,000 sq.ft. Inventories are carried at $83,978,463.

Higher Rates Natural Result of Coal Miners' Wage Increase

"INCREASED coal costs due to the 27 per cent raise in miners' wages will result in a 15 per cent increase in the cost of producing electrical energy, and the natural result must be an increase in rates throughout the country; in fact, the United States Bituminous Coal Commission, in its majority report, urges state commissions and other regulatory bodies to take into consideration the increased cost of coal in fixing rates for public utility service."

The above statement was made by Executive Manager M. H. Aylesworth of the National Electric Light Association after careful consideration of the text of the Coal Commission decision.

"Without passing upon the question of whether the coal operators are earning sufficient return upon their investment, or upon the question of whether coal miners, even under the increased wage scale, are receiving ample compensation for their work, it is very apparent that the increased cost of coal to the public utilities of the country must be absorbed in some manner," he continued. "It is equally apparent that public utilities under regulatory bodies have been allowed to earn only a fair return upon their investments, and in many cases not even that, so that it is impossible for them to absorb any increased cost of production without increasing their rates.

"More than 27,000,000 tons of coal is used yearly by electric public utilities of the country. The cost of this coal represents about 60 per cent of the cost of service by these utilities. Ninety-eight per cent of all coal used by electric public utilities is so-called 'contract coal,' which therefore must absorb the entire 27 per cent of the increase in wages. The remaining 2 per cent is exempt from the absorption of the increase of 14 per cent fixed by tentative agreement between operators and miners pending the decision by the commission, but of course it must absorb the additional 13 per cent allowed in the recent order."

In its opinion the Bituminous Coal Commission advocates a seasonal freight rate and a seasonal reduction in cost of coal to encourage storage in the summer months.

This is in line with suggestions made by N. E. L. A. representatives in a hearing before the commission and also in a hearing before the Senate committee on interstate commerce.

Mortimer Resigns from North American Company

AT A MEETING of the directors of the North American Company held in New York on Tuesday, James D. Mortimer offered his resignation as president of the company, to become effective Nov. 1. At the same time the directors voted to withdraw from the consideration of the stockholders the project for classifying the capital stock. This plan contemplated the creation of 297,933 shares of $50 par value of preferred and an equal number of shares of common of $25 par value. William Nelson Cromwell was elected chairman of the board to fill a vacancy which has existed since the death of George R. Sheldon. Albert B. Boardman was elected to fill a vacancy in the board.

No announcement could be had from the office of the North American Company relative to the plans of Mr. Mortimer after Nov. 1. His successor has not yet been chosen.

Big Membership Drive by Society for Electrical Development

BELIEVING that every central station, jobber, manufacturer and contractor-dealer within the electrical industry profits directly or indirectly by the work of the Society for Electrical Development, and that each one would profit infinitely more were he a member of that body, an intensive membership drive has been started by the society, with the slogan "A thousand new members by July." Since the signing of the armistice, the society's membership list has grown. Old members who were forced to withdraw on account of the curtailments made necessary by the war have all returned, and in addition a gratifying number of new members have joined.

An extensive direct-by-mail campaign has been mapped out. The first piece of this series has already gone out in the form of an enlarged letter, setting forth a few of the advantages of membership in the society. This will be followed by a broadside explaining more in detail the scope of the society's efforts and giving concrete evidence of benefits which present members are receiving. Other mailing pieces will follow to tell completely the story.

Because an increased membership, meaning increased funds, will also benefit existing members, all those now belonging to the society are being urged to "boost" the society and to obtain applications.

The annual meeting of the society is scheduled for Tuesday, May 4, and will be followed by a meeting of the board of directors.

F. W. Loomis has been traveling through the Southwestern and Middle West sections of the country on behalf of the society. He remained in Kansas City for a week and helped W. B. Satterlee with the electrical campaign which was conducted there by the local electrical interests. The society supplied the design used for the campaign poster and the copy used in the daily newspaper full page advertisements.

Utility Development Fostered by Norfolk, Va.

CAPITAL legitimately invested in public utility properties must be safeguarded and protected by municipalities, both as to principal and as to a just and inviting return thereon after reimbursement to the company for expenses incurred in providing service. This platform has been adopted both by the Public Utilities Commission of Norfolk, Va., a local body which acts in an advisory capacity to the City Council, and by the latter body itself as that by which they will be governed in their dealings with public utilities. Practically interpreted, it means that the city declares its conviction that the encouragement and development of the utilities is necessary to the welfare of the community, and that it stands ready to enter into proper business relations with these bodies in order to insure the safety of their invested capital and a reasonable return upon it.

The particular case which caused this action is one in which the City Gas Company of Norfolk, included in the system of the Virginia Railway & Power Company, petitioned for an increase of gas rates from a base rate of $1.20 per 1,000 cu. ft. to $1.60. A. Merritt Taylor and Charles B. Cooke, Jr., of Philadelphia, were employed to make a valuation of the gas property, and upon the figures arrived at by them and accepted by the company and the city a cumulative return of 8 per cent was guaranteed. On this basis the company's requested rate was found to be justified.

Before the agreement can be consummated it must be indorsed by the State Corporation Commission. That body has shown itself to be as broad in its views as the local body, and, while it has reserved the right to check the figures in detail, its chairman, reasserting the commission's belief that unless public utilities get some relief and unless their business is recognized on a business basis Virginia will either lose its utilities or get poor service, says:

"In the present instance it seems a *prima facie* case, and it appears the commission's duty to approve this agreement."

Important Progress in Development of Moore Lamp

DEVELOPMENT of the Moore lamp, in which light is produced by the passage of electricity through a gaseous conductor, has come to the point where the lamp can be operated from 220-volt circuits without the use of any auxiliary starting device. This announcement was made by D. McFarlan Moore, of the General Electric Company, in an address to the New York Section, American Institute of Electrical Engineers, on March 26.

Mr. Moore gave a brief historical sketch of the history of light from gaseous conduction. He then showed some lamps, about the size of the ordinary incandescent lamps used for street lighting, which were provided with the usual Edison base for use on low-voltage circuits. The gas used in these lamps is neon and the characteristic color is orange. Although the supply of neon has not been sufficient in the past for any great commercial development, Mr. Moore declared that there is now assurance of an adequate supply for use in these lamps. He predicts a large development in gaseous conduction lamps with other gases as well as neon.

Kansas Industrial Court Grants Topeka Linemen More Pay

THE first wage controversy submitted to the new Kansas Industrial Court resulted in a marked increase in wages and new working conditions for linemen employed by the Topeka Edison Company. The company was ordered to pay its linemen 67½ cents per hour for an eight-hour day, which is an increase of 7½ cents an hour over the present wage of the linemen and 2½ cents an hour less than the men had asked before the proceedings in the Industrial Court were brought.

Automatic Telephone for New York City

ANNOUNCEMENT is made by the Western Electric Company that the installation of automatic telephone exchanges is to be commenced at once in New York City by the New York Telephone Company. After nearly fifteen years of experimental work and laboratory trial periods the Western Electric Company feels that it has developed a satisfactory machine-switching equipment which is almost 100 per cent foolproof and will eventually do away with manual operators. The initial installation of the automatic system will replace three of the present exchanges in New York. No interruption or confusion in the telephone service is expected as the conversion will, of course, be very gradual.

Some idea of the amount of engineering and preliminary work required in making this change-over may be had when it is stated that at the present time in the Western Electric Company's engineering offices there are 350 engineers and draftsmen devoting their entire time to the further development of machine switching and apparatus. In one machine-switching office the engineering for which has been completed recently the equipment and circuit drawings covered an area of 5,000 sq. ft., and that was for only one set of drawings.

Utility Banker Urges 9 Per Cent Return

PUBLIC Service Commissions in restricting electric utilities to earning a return of not over 8 per cent on invested capital have seriously impaired the credit of these utilities, declared H. L. Clark, vice-president of E. W. Clark & Company, public utility managers and investments bankers, Philadelphia, to a representative of the ELECTRICAL WORLD. At the present time, it was pointed out, investors demand a higher interest rate than ever before, and to attract new capital public utilities must offer securities at a price to net a return of 7 per cent or more. This means that the marketing expense of such securities will bring the cost of new capital to between 7.5 and 8.5 per cent. To attract new capital for vitally needed extensions and improvements, utilities, in Mr. Clark's opinion, should be permitted a return of at least 9 per cent.

"In many cases," stated Mr. Clark, "the rate schedules for electric service established by the Public Service Commissions do not permit a company to earn over 6 per cent above depreciation charges. This brings up the question of valuation, which at this time is very important, not only for the purposes of rate making but also from the investor's point of view. For every $100 of investment the security holders should at all times be assured that there is $100 of assets either in property or reserves. With this in view a company is entitled to include in its rates an amount sufficient to offset depreciation and obsolescence and enable it to keep up its plant and system in good operating efficiency and physical condition.

"To insure the quality of service now demanded by the public, commissions should be liberal in the matter of depreciation. In making valuations, the original cost, the cost of reproduction at present-day prices, no deductions for depreciation and a substantial addition for going value should be allowed."

In summing up the situation, Mr. Clark stated that in his estimation the outlook for public utilities is improving as the high point of operating costs already has been passed. But to attract the new capital necessary for development and extensions electric utilities, it was pointed out, must be allowed to earn more. He pointed out that the return required by investors in public utility securities is substantially greater than five years ago, and that Public Service Commissions in establishing the rate of return allowed must take into consideration these conditions: First, that all capital demands a higher return; second, that the credit of public utilities has been impaired by injudicious regulation, and, third, that the regulating authorities must realize that they cannot force into the utilities the large amount of capital required, but must make the investment attractive.

Rural Rates Debated by Wisconsin Electrical Association

CONSIDERABLE interest was taken in the report of the committee on rural line extensions of the Wisconsin Electrical Association, G. C. Neff, chairman, on the second and last day of the association's convention last week. In addition there were papers devoted to valuation and to automatic substations.

Equitable city rates plus the increase in fixed charges, energy losses and operating expenses incident to rural service were proposed for adjacent rural communities. The general practice of having farmers' lines exclusive of the necessary watt-hour meters financed wholly by the consumers was approved. Under this plan the utility is not entitled to earn interest on the investment, but it should earn annually, in the estimation of the committee, an amount equal to 10 per cent on the investment to cover the hazard of conducting the business, taxes, depreciation, maintenance and service.

A number of members thought the rural minimum charge would be too low under the proposed rate and favored a minimum of about $5. In reply, Mr. Neff said that the rate suggested by the committee was designed to encourage the increased use of energy. The greater the energy consumption the lower the additional rural charge would be, and vice versa.

The following officers were elected for the ensuing year: President, W. C. Lounsbury, general manager Superior (Wis.) Water Light & Power Company (re-elected); first vice-president, L. N. Boisen, vice-president Ashland (Wis.) Light, Power & Street Railway Company; second vice-president, Harold L. Geisse, vice-president Wisconsin Power & Light Company, Janesville, Wis.; third vice-president, P. D. Kline, vice-president and general manager Wisconsin & Minnesota Light & Power Company, Eau Claire, Wis.; secretary-treasurer, J. P. Pulliam, vice-president Wisconsin Railway Light & Power Company, Milwaukee (re-elected). The report of the first day of the convention appeared in the ELECTRICAL WORLD last week.

Great Lakes Section, N. E. L. A., Tentatively Approved

TENTATIVE approval was given to the plan of consolidating Wisconsin, Illinois, Indiana and Michigan into a "Great Lakes" geographic section of the National Electric Light Association at a recent conference in Chicago between M. H. Aylesworth, executive manager of the national body, and the presidents and secretaries of the four interested state associations. This will make the eleventh of the thirteen proposed geographic sections.

Besides maintaining their identity in the new organization, the state associations will have more responsibility given to them than they have now, because the national body will handle problems of a national character only.

The state representatives at the Chicago meeting were W. C. Lounsbury, Superior, Wis.; J. P. Puilliam, Milwaukee, Wis.; B. J. Denman, Moline, Ill.; R. V. Prather, Springfield, Ill.; W. M. Lewis, Muskegon, Mich.; H. Silvester, Ann Arbor, Mich.; P. H. Palmer, Kokomo, Ind., and T. G. Donohue, Lafayette, Ind. These were the presidents and secretaries respectively of the four state associations. They had not all been authorized to take final action on the proposition, but they agreed that the plan for reorganizing the N. E. L. A. so that it would include geographic sections was essentially correct and that they would recommend their respective state associations to give full co-operation to the plan.

Revisions to National Electrical Code

MOST of the changes to the National Electrical Code as outlined in the ELECTRICAL WORLD Feb. 14, 1920, were adopted after a public hearing on March 23. The final revision differs from these outlined changes in the following points:

The limit of low potential systems was fixed at 600 volts. The proposal to require polarity identification in all wires installed on and after Jan. 1, 1921, was modified to require that beginning July 1, 1921, twin wires for conduit work and twisted-pair wires for armored cable in sizes No. 12 and No. 14 B and S gage provide the means for continuous identification proposed in the bulletin for Rule 26-a. Rule 77 on fixtures is to be revised to require the identification marking by the fixture manufacturers of the wire connected to the screw shells of the socket.

In Rule 70-d, 2 on cabinet and outlet boxes, if the door is of No. 12 gage metal or over, an air space of one-half inch is allowed. Varnished cloth cable is limited to size No. 6 B and S gage and larger for general use. An amendment to 71-b provides that fuseless rosettes may be rated 660 watts at 250 volts and not over 6 amp.

Under the subheading of fixtures (Rule 30a) it was decided that insulating joints may be omitted in the case of straight electric fixtures installed on grounded raceways when the grounded wire of the circuit is connected to the screw shell and when approved fixture wire is used.

In the section on grounding the grounding of motors and generators operating at 150 volts or less and not accessible to other than qualified operators is not to be required. The recommendation to require externally operated inclosed type switches for motor circuits was not adopted. A substitute for Rule 23-d requires that service fuses must be enclosed unless connected to be cut off the supply circuit by the service switch or mounted on switchboards under competent supervision. Service switches may be located outside of buildings. It was ruled to amend 8-f to read that motors having brushes or sliding contacts exposed to combustible dust must be placed in non-combustible enclosures provided with ventilation to outside air. Under extreme conditions as in flour mills, grain elevators, etc., squirrel cage motors should be similarly enclosed.

A supplementary report on radio equipment described in the ELECTRICAL WORLD March 13, 1920, was adopted. Section e of the present Rule 13 is to be retained. Regarding oil transformers, drains in vaults are not required in certain cases. In regard to wattage limits for branch-lighting circuits special permission for 1,320 watts on circuits with medium-base sockets is still required. The recommendation to change 1,320 watts to 1,500 watts was not adopted. Provision was made for circuits up to 4,000 watts when mogul sockets are used, but special permission will be required. Under Rule 34 circuits of 4,000 watts will be permitted by special permission. Rule 26-g to 26-j retains the wording of the 1918 code except for the addition in the last sentence in proposed Rule 26-j as printed in the bulletin and except for recognition of varnished cloth insulation.

The report of the committee on reconciling the national electrical code and national electrical safety code were adopted except that present Rule 15-a is retained.

First Quarter Financing More Than $80,000,000

BOND and stock issues of public utilities for March show a decided increase over February not only in the number of companies represented, but also in the amount of money involved. Thirteen companies have borrowed a total of $34,562,940 at between 7 and 8 per cent interest. This brings the total since the beginning of the year to $81,280,940. About $24,000,000 of the March total is in notes and bonds, the rest in stock. As the table shows, there are only two ten-year bond issues, these amounting to $8,503,000; the remainder, representing nine companies, are made up of short-term obligations for three years or less. In every case the same high rate of interest prevails. Whether the issue is to fall due in ten years or one, the terms are such that the investment will yield between 7 and 8 per cent. The issues in detail follow:

Company	Amount of Issue	Period	Class of Security	Rate of Interest	Per Cent Yield	Offered at
Brooklyn Edison Co.	$3,000,000	10-year	General mortgage gold bonds	6	7.25	92½
Cincinnati Gas & Electric Co.	2,400,000	3-year	Gold notes	6	7	97½
Detroit Edison Co.	5,503,500	10-year	Gold debenture bonds	7	7	100
Eastern Wisconsin Electric Co.	1,200,000	3-year	General mortgage gold notes	7	7.8	98
Richland Public Service Co.	850,000	3-year	Gold notes	7	7.6	98½
Denver Gas & Electric Light Co.	2,000,000	2-year	Notes	7	7.25	98
Trumbull Public Service Co.	360,000	3-year	Mortgage notes	7	7.65	98.4
Oklahoma Gas & Electric Co.	3,500,000	1-year	Gold notes	7	7.8	99½
Georgia Railway & Power Co.	2,500,000	2½-year	Gold notes	7	7.5	99
Edison Electric Illuminating Co. of Brockton	649,440		Stock			110
Merchants' Heat & Light Co.	600,000	1-year	Gold notes	7	7.56	99½
Dayton Power & Light Co.	2,000,000	3-year	Bonds	7	7.6	98⅝
Ohio Cities Gas Co.	10,000,000	.....	Preferred stock	8		

Arizona Utilities May Make Extensive Improvements

REPRESENTATIVES of many of the electric light and power companies and other public utility corporations of Arizona have conferred with the State Corporation Commission in regard to plans for extensive improvements the making of which would involve an increase of rates. It was stated at the conference that the electric companies alone purpose to spend not less than $5,000,000 in improvements. Several of these plants are to be enlarged in order to meet the increasing demand for power.

Companies represented at the hearing include the Globe Light & Power Company, Tucson Electric Light & Gas Company, Pacific Gas & Electric Light & Power Company, Flagstaff Electric Light Company, Bisbee Improvement Company, Desert Power & Water Company, Southside Gas & Electric Company, Arizona Power Company, Bisbee-Naco Water Company, Yuma Gas, Light & Water Company and Tucson Rapid Transit Company.

Ohio "White Ways" to Be Paid for by Owners of Abutting Property

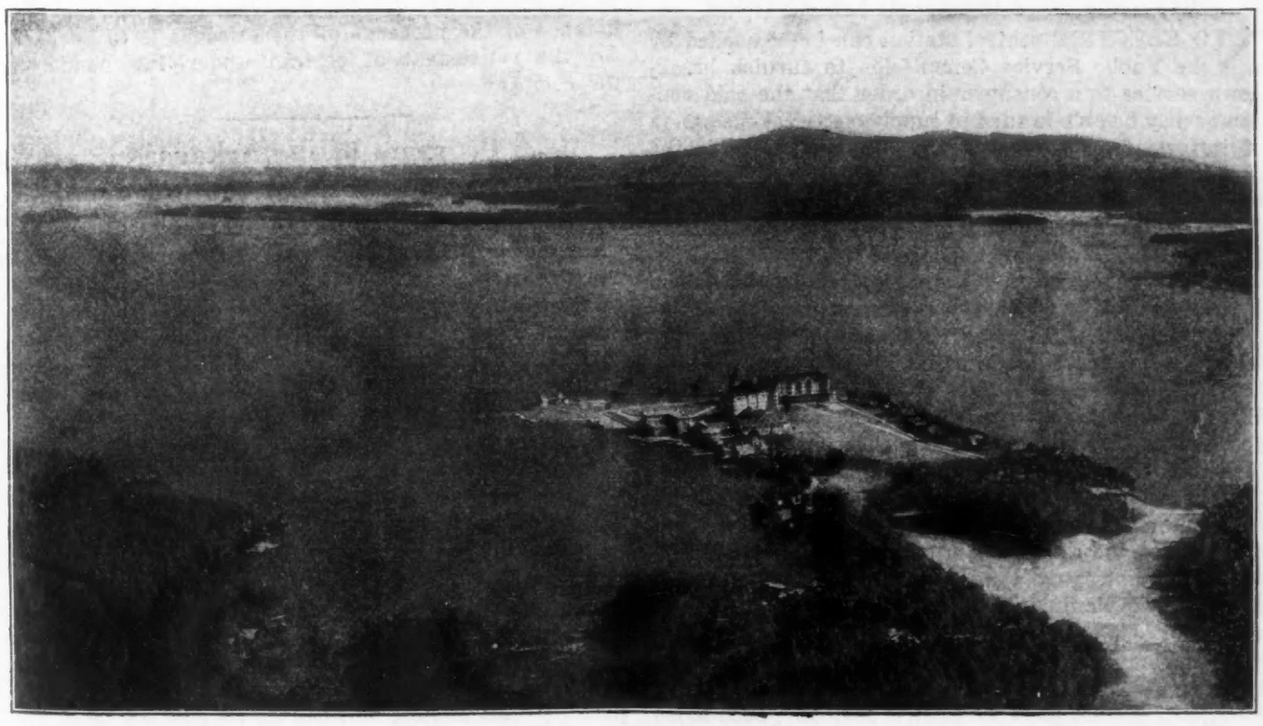
A BILL to assess the cost of "white way" lighting upon the owners of the abutting property was passed by the Ohio State Legislature before its recent adjournment. By the terms of this law a municipal council may install a "white way" system on any public way upon the petition of owners of adjacent land with a valuation reaching three-fourths of that of all the property affected, and special assessments may be levied upon such owners for part or all of the cost. The assessments so levied may be collected in one or more instalments in the manner provided in the case of assessments for street improvements, and the legislative body may levy and provide for the collection of such assessments at any time before or after the completion of the lighting system. Any such assessing ordinance may be made to include the property specially benefited by such lighting system and may include property abutting upon any one or more streets or public places or parts thereof which are lighted by it.

The legislature declined to permit the cost of general street lighting to be assessed against abutting property, confining the law to boulevard or "white way" illumination.

Increased Production to Be the Keynote at Chamber of Commerce Meeting

WHEN the Chamber of Commerce of the United States meets in convention at Atlantic City, N. J., on April 27 to April 29 the one object it will keep to the front in addresses, papers and discussions will be to devise means of increasing production and thus restoring normal business conditions and reducing inflated prices. To this end discussions will range around government functions as they have been exercised in anti-trust legislation and in taxation; transportation, both land and water; international finance as the financier and the business man respectively view it; agriculture from the standpoints of the government, the farmer and the business man; labor as the employers on the one hand and the employed on the other see it, and topics closely related to these. In addition there will be group industrial meetings.

New England Convention Spot



For its annual convention, Sept. 14-16, the New England Section, N. E. L. A., will meet at one of New England's most beautiful resorts, the Mount Kineo House, Moosehead Lake, Kineo, Maine. In the background rises Squaw Mountain, and at the extreme right is the beginning of Kennebec River, the lake outlet.

McCarter Calls for Accelerated Commission Processes

DECLARING that the regulated public utilities have had to look solely to the public service commissions for relief from the almost intolerable burdens following the war—burdens which unregulated industries have been able to adjust—and that popular sentiment which insists that utilities must continue to function at pre-war rates is unreasonable, Thomas N. McCarter, president of the Public Service Corporation of New Jersey, in the report of that corporation for 1919, just issued, says:

"Conditions that have existed for the past two years make it imperative that commissions should act in such a crisis in a more or less summary manner. Protracted hearings, extending over months or years, defeat their object. When a patient is attacked by appendicitis an operation at the moment is often the only recourse."

Mr. McCarter points out that when the credit of public utilities is destroyed by a process of starvation two things happen: they cannot distribute satisfactory returns to existing investors and they cannot obtain new capital. Consequently no additional service can be provided and development in the territories served ceases, with resulting loss of prosperity all around.

The subsidiary Public Service Electric Company reports an increase in commercial sales of energy of 1,965,155 kw.hr., or 0.45 per cent. The revenue from electric sales showed a gain of 14.34 per cent, with an average price of 4.43 cents per kilowatt-hour, compared with an average price of 3.90 cents per kilowatt-hour in 1918. The war-time load was absorbed by other industries. A reserve supply of 220,000 tons of coal carried the company successfully through the strike.

New York Court Rules Against Compulsory Sale of Energy to Competitor

NO ELECTRIC central station can be compelled by the Public Service Commission to furnish break-down service to a consumer in order that the said consumer may be able in turn to supply electrical customers of its own from the energy so obtained. This is the decision of the Appellate Division of the Supreme Court of the State of New York in a case carried to it by the New York Edison Company on appeal from the decision of the Public Service Commission, First District.

The customer concerned is the grocery firm of Acker, Merrall & Condit, which has a generating plant of its own, from which it serves its tenants and other customers in the same block. Finding its supply of electricity insufficient, this firm applied to the New York Edison Company for break-down service. The company declared its willingness to furnish such service to Acker, Merrall & Condit for their own use and that of their tenants on condition that they would not use the service to supply customers in other buildings, contending that by doing so the grocery firm became a competing company and pointing out that there are more than six hundred private plants in New York which could, if the electric company's contention were overruled, all use that company's product to supply customers of their own. Not being obliged to maintain equipment for emergency service as is the electric company, such firms could underbid the latter. As a matter of fact, according to the judicial finding, Acker, Merrall & Condit retailed the energy received from the Edison company at a price 15 per cent less than that company's scheduled rates.

The Public Service Commission ordered the Edison company to supply Acker, Merrall & Condit with the break-down service. The Appellate Division of the Supreme Court, however, was unanimous in reversing the commission's order, finding that the resale of energy to outside concerns was not a proper use of break-down service and that alleged discrimination did not exist, the cases cited to the contrary involving no feature of competition as in the case under review.

Two 140,000-Volt Lines for Michigan System

CONSTRUCTION of two 140,000-volt transmission lines totaling 70 miles (112 km.) in length is a feature of an extensive development program to be carried out in Michigan by the Consumers' Power Company during 1920. One of the transmission lines, 26 miles (41.6 km.) in length, from Argenta to Battle Creek, will tie together a 30-cycle and a 60-cycle system. Frequency changers will be installed at Battle Creek. The other line connects Battle Creek and Jackson, a distance of 44 miles (70.4 km.). As a result of these connections the company will not only improve operating conditions but will add approximately 30,000-kw. capacity to its system.

Other additions to the company's property include a new 10,000-kw. steam unit and new boilers, condensing apparatus and general betterments in the various steam plants.

These improvements will be financed by about $6,000,000 of the proceeds from the sale of the Consumers' Power Company $5,000,000 general and refunding mortgage bonds and $3,000,000 debentures, as reported in the ELECTRICAL WORLD of Feb. 14. The balance of the proceeds of these issues is to be used for the retirement of certain underlying bonds of the company.

Program of the Arkansas Association Convention

THE annual meeting of the Arkansas Utilities Association will be held at the Arlington Hotel, Hot Springs, Ark., April 26, 27 and 28. At the conclusion of the reading of the committee reports at the opening session Governor Charles H. Brough will speak on "Arkansas' Attitude Toward Public Utilities." This address is to be followed by a paper on "Lightning Protection," by J. L. Buchanan, president Wesco Supply Company, St. Louis, Mo. The afternoon will be devoted to an inspection of the local utilities. The program for April 27 includes a paper by O. P. Barnell, Westinghouse Electric & Manufacturing Company, on "Underfeed Stokers"; a paper by P. W. Thomas, Arkansas Light & Power Company, Pine Bluff, Ark., entitled "Coal versus Oil," and a paper by W. G. Schmander, Texas Power & Light Company, Dallas, entitled "Present-Day Operating Problems." On April 29 Herbert R. Wilson, chairman of the Arkansas Corporation Commission, will deliver an address, upon the conclusion of which there will be a discussion on the topic "Public Policy and Good of the Association."

Public to Have Benefit from Government Inventions

THE bill authorizing the Federal Trade Commission to accept and administer for the benefit of the public inventions and patent rights which have been developed within the government service has been passed by the Senate and now goes to the House, where an effort will be made to obtain its prompt consideration. The passage of the bill is made possible by the withdrawal of objections by Senator Smoot, who had delayed passage of the measure because he believed the powers should be given to the Department of the Interior rather than to the Federal Trade Commission.

The committee on patents amended the original bill so as to allow such patents to go through the Patent Office without the payment of fees. The original bill had provided that each department should pay the fees out of its own appropriation.

New Lines for Central Illinois System

CONSIDERABLE construction work for the purpose of increasing capacity, tying in the system and shutting down isolated steam plants has been and is under way by the Central Illinois Public Service Company. A high-tension transmission line being constructed from Robinson to Palestine will permit the discontinuance of the present isolated steam plant at Palestine. The 33,000-volt transmission line between Bridgeport and Stoy is now in operation, connecting the Robinson-Oblong group with the Lawrenceville-Olney group and making it possible to close down the Robinson generating plant, except for stand-by purposes. The company has secured a renewal of the franchise in Edinburg.

There has been authorized the installation at the company's largest station, Muddy, near Harrisburg, Ill., of a third 6,250-kva. steam-driven turbo-generating unit, together with the necessary additional 686-hp. boiler and other apparatus. With the completion of this work, about July 1, the total capacity of the Muddy power station will be 25,000-hp.

The Pontiac-Fairbury transmission line was placed in service during February, enabling the Central Illinois Public Service Company to secure 500 kw. from the Public Service Company of Northern Illinois at Pontiac to supplement the Watseka power station and supply additional load in Division "P," formerly the Central Illinois Utilities Company.

The Central Illinois Public Service Company purchased on Jan. 1 the entire capital stock of the Central Illinois Utilities Company, Hoopeston Gas & Electric Company, Hamilton Utilities Company and the Eastern Illinois Ice Company. This advantageous purchase adds properties with gross earnings in 1919 of $543,987.

Further Interconnection in Eastern Pennsylvania

IN ADDITION to the tie-in lines with the Lehigh Navigation Electric Company at Tamaqua and the Schuylkill Gas & Electric Company at Frackerville, the Eastern Pennsylvania Light, Heat & Power Company of Pottsville has just entered into a contract with the Metropolitan Edison Company of Reading for an interconnection at a point south of Port Clinton on the border of Berks County. For this purpose there is now being erected a three-phase, 60-cycle, 23,000-volt transmission line which will be approximately 16 miles long. Line conductors of No. 1 solid copper and 45,000-volt insulators will be used so that at a later date the line can be changed over for 38,000-volt operation.

The Eastern Pennsylvania Company, of which C. A. Hall is manager, is in the position where demand far exceeds plant capacity. In addition to the interconnections considerable apparatus is to be installed to increase capacity.

Question-Box Conference Brings New Englanders Together

TWO hundred representatives of all branches of the electrical industry met at the American House, Boston, March 18, under the auspices of the New England Section of the National Electric Light Association to hold an all-day question-box conference. The program was confined largely to questions and discussions of commercial policy, merchandising of appliances, central-station service matters and public relations. C. R. Hayes, president of the New England Section, was general chairman.

A notable feature of the meeting was the presence by invitation of members of the Massachusetts branch of the National Association of Electrical Contractor-Dealers and representatives of the New England Electrical Supply Jobbers' Club. A committee consisting of William Gould, chairman, R. D. Cutler and J. T. Day was appointed to serve as a "contact committee" for conference with other branches of the industry.

President Hayes stated that, in his opinion, the relations between the different branches are far ahead of those of five years ago. In later issues résumés of the topical discussions which occupied the sessions will be printed.

Need for Trained Electric Furnace Men to Be Discussed

DEFINITE plans have now been made for the meeting of the Electric Furnace Association in Boston. The business meeting and election of officers will be held at the Copley-Plaza Hotel during a luncheon on Thursday, April 8, and afterward there will be a general meeting, which will be open to all who are interested in the electric furnace industry. The subject of the discussion will be "Adequately Trained Men an Urgent Need of the Electric Furnace Industry." This subject has been chosen at the instance of a number of electric furnace operators. Papers have been prepared by makers of furnaces and equipment and by electric steel manufacturers. A number of engineering institutions will also discuss what they are doing to train men for metallurgical work.

The following day the association will join with the American Institute of Electrical Engineers and the American Electrochemical Society in their discussions on "Electrically Produced Alloys" and "Power for Electrochemical Purposes." During the afternoon the members of all three organizations will probably make an inspection trip to the plant of the General Electric Company at Lynn.

The joint program was printed in ELECTRICAL WORLD last week on page 747.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Southern California Edison Employees' Stock.—More than 60 per cent of the permanent employees of the Southern California Edison Company were stockholders at the end of last year, and the number is continually increasing.

Radio-telephony in the Air Service.—The Air Service division of the War Department announces that Lieut. Stanley Smith has succeeded in talking by wireless with Fort Sam Houston, Tex., from a distance of 12 miles, exceeding by 7 miles the previous record distance for the apparatus used.

Penn Central Employees Organize.—Employees and officials of the Penn Central Light & Power Company have organized the Penn Central Patriotic and Beneficial Association. Each member will pay one-half of 1 per cent of his salary into a fund to provide benefits in case of accident, illness or death, and the company will add an equal sum, paying dollar for dollar.

Municipality Raises Rates by Eliminating Discount.—The City Council of Garrett, Ind., has discontinued the discount which had been allowed on bills for electric service furnished by the municipal plant. The discount for the entire town amounted to about $200, and it is hoped that the collection of this additional amount per month will obviate the necessity of revising the rate schedules upward.

Electrically Developed Blueprints.—Finding that its average weekly expense for blueprints, measuring in all 250 sq.yd., was about $160 and that the printing was sometimes delayed for days at a time, the San Joaquin Light & Power Corporation of Fresno, Cal., has installed an electrically operated outfit which turns out the same quantity of blueprints promptly and at an expense of not more than $50, or a saving of two-thirds the former cost.

Preventing Forest Fires by Wireless Telephony.—Preliminary tests of the wireless telephone in Oregon have led the Forest Service to think that it will prove of great utility in preventing fires in the national forests. One of the sets used was installed on Mount Hood, where the problem of providing a satisfactory support for the antennas was a difficult one, since a mast was needed which would be strong enough to resist the gales that sweep the mountains at 70 or 80 miles an hour and at the same time be light enough to permit of its being raised and lowered before and after sleet-storms. A 50-ft. bamboo pole was finally selected for the purpose.

New Bedford Company to Issue Stocks—The New Bedford (Mass.) Gas & Edison Light Company is to issue $447,000 additional capital stock and $447,000 in 6 per cent bonds to meet the cost of plant enlargement demanded by increasing business.

Fuel Scarcity Prevents Plant Extension.—Owing to the scarcity of coal and oil fuel the South Norwalk (Conn.) electrical commissioners have been forced to hold in abeyance plans that had been made for increasing the capacity of the municipal plant in that city to take care of increased business.

National Immigration Conference.—Leaders in American industry and finance will discuss shortage of labor, the industrial unrest and the whole question of immigration at a conference to be held in the Engineering Societies Building, New York City, next Wednesday, April 7. Coleman du Pont, 120 Broadway, New York, will supply details of the meeting.

To Help Supply Electrical Help.—Because there is a shortage of master electricians in New York City and the code and rules are so complex that only twenty-five out of every hundred trying for a master's license or special maintenance license are able to pass the examinations, the West Side Young Men's Christian Association of New York has arranged for a special course of instruction in the code. John Domerhuizen, former city inspector and examiner for the Department of Water Supply, Gas and Electricity, will teach.

Cleveland Electrical Show a Great Success.—The Cleveland Electrical Show, held from March 10 to March 20 under the management of the Electrical League of that city, proved a greater success than even the most optimistic of its promoters anticipated. An average daily attendance of more than 15,000 was recorded, the majority being buyers rather than curiosity seekers. On one day more than 20,000 admissions were received, this being the highest daily attendance. At the close of the third day of the show orders totaling more than $1,000,000 had been booked by exhibitors.

Coming Electrical Shows.—An electrical show is to be held in Ardmore, Okla., under the auspices of the Consumers' Light & Power Company on April 7 to 10, inclusive. Montpelier, Vt., will hold one in June, and Worcester, Mass., one in September. The Worcester show will be held in Mechanics' Hall through the co-operation of the Worcester Electric Light Company and local jobbers and contractor-dealers. Indiana and Kentucky have combined for the purpose of holding an electrical exposition at Louisville on Oct. 25 to 30, inclusive, in the Jefferson County Armory, which is one of the largest structures of its kind in the United States. The Electric Club of Louisville is sponsor for the exposition, of which Robert Montgomery, manager of the commercial department of the Louisville Gas & Electric Company, has been appointed general manager.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Institute of Radio Engineers.—On Wednesday evening, April 7, Dr. Louis W. Austin, head of the navy's radio-telegraphic laboratory at Washington, will speak before this institute at the Engineering Societies Building, New York, on "The Reduction of Atmospheric Disturbances in Radio Reception."

New York Section, I. E. S.—"Searchlights in the A. E. F.," by Doraf Wilmot Blakeslee, and "Historical Sketch of Street Lighting," by P. S. Millar, are the titles of the papers to be presented at the April meeting of this section of the Illuminating Engineering Society, to be held on Thursday evening next at the Engineering Societies Building.

Electric Hoist Manufacturers' Association.—The annual meeting of the Electric Hoist Manufacturers' Association was held in New York City on March 18. J. B. Adams of the Franklin Moore Company, Winsted, Conn., was elected chairman of the association; R. H. McGredy of the Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., vice-chairman, and E. Donald Tolles, 52 Broadway, New York City, secretary-treasurer. The next meeting of the association will be held at 9 East Fortieth Street, New York, on April 15.

Proposed Cornell Engineering Society.—A meeting of graduates in engineering at Cornell University will be held on the evening of April 9 in the Engineering Societies Building, New York. The meeting is called by the Cornell Society of Civil Engineers partly with the idea of forming a general Cornell engineering society, now that the different engineering schools at Cornell are to be combined into one general engineering college. The new dean of the combined college, Prof. Dexter S. Kimball, will be one of the speakers.

A. I. E. E., Philadelphia Section.—Dr. Comfort A. Adams will speak before this section at the Franklin Institute on "Electric Welding as Applied to Shipbuilding" on Thursday, April 8, instead of on April 12, as announced last week. On April 12 Frank B. Evans, Jr., of the Bell Telephone Company will discuss "Traffic Engineering" at the Engineers' Club. On Monday, May 10, "students' night," a dinner at the Engineers' Club will be followed by a discussion of "Professional and Financial Aspects of Electrical Engineering," to be participated in by students and graduates of technical colleges.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Amortizing Maintenance Charges.—That an excessive sum paid for repairing the boiler of a public utility should not be charged against operating expenses of any one year but amortized over a period of years was the decision of the Public Service Commission of Missouri in a recent rate-fixing case.

Sale of Surplus Energy Does Not Constitute a Utility Business.—The sale of surplus electric energy of a private industrial concern to a few customers within a limited area does not constitute a public ultility business within its jurisdiction, the Missouri Public Service Commission has declared, where there is no profession of public service, and the mere fact that service is being rendered across a public street is immaterial.

Competing Company Authorized Because of Poor Service.—Declaring that the Lisbon Falls Electric Company has failed in its duty to its community, supplying service "of the worst possible character" and standing "in a defiant attitude" to the public and the commission, the Public Utilities Commission of Maine has authorized the Maine Power Corporation to enter that territory and "furnish electricity for any and all purposes in any part of the town of Lisbon."

Charging for Service Not Actually Rendered.—The Public Service Commission of Pennsylvania has ordered the Greencastle Light, Heat & Power Company to restore to a former customer service discontinued upon his refusal to pay a charge of $1.66 for meter connection after he had moved from one house to another. The commission held that the company did not connect the meter at the complainant's new house and performed no physical service in connection with it.

Public's Interest in Relation of Corporations to Each Other.—In granting approval of the application of the Sierra & San Francisco Power Company for authority to lease to the Pacific Gas & Electric Company all of its properties for fifteen years, the presiding commissioner, listing the proposed additions and betterments which for nearly two years had been deferred by the inability of the Sierra & San Francisco company to sell bonds, but on which, in anticipation of the commission's sanction, preliminary work had already begun, declared that these "will materially improve service and increase power supply, as well as reduce cost of operation. In the opinion of the presiding commissioner, the lease is distinctly in the in terest of the public."

Montana Commission Condemns Inadequate Rates.—In granting increased rates to the Range Power Company of Polson, Mont., the Public Service Commission of that state condemns the former schedule, based on franchise requirements, as unsound and improperly balanced. The residence consumer, for instance, paid a maximum rate of 12 cents a kilowatt-hour against 6½ cents paid by merchants, and the company's rate of 1 cent for municipal pumping was below the cost of production. The new general rates provide a sliding scale of from 15 cents down to 6 cents a kilowatt-hour, according to consumption, with a minimum charge of $1.50.

High-Tension Supply to Industrial Plant Authorized.—The New England Power Company has been authorized to build a 66,000-volt branch line from Dunstable to the Nashua River Paper Company's factory at Pepperell, Mass., to supply about 1,500 kw. to this establishment. The local central-station interests, the Pepperell Electric Light & Power Company and the Shirley Electric Company informed the Massachusetts Department of Public Utilities that as their lines are overloaded and they are not in a position to finance the necessary increase of distribution system capacity, no objection would be interposed to the entrance of the New England company's service, provided that the 300 hp. and 450,000 hp.-hr. annual minimum established in the Fitchburg case were applied by the commission in this instance. The commission so ordered.

Principles of Valuation.—The sale price of recently exchanged land almost contiguous to public utility land to be valued is the best evidence upon which to compute the fair present value of the utility's land for rate-making purposes, according to the decision of the Public Service Commission of Missouri in the complaint of the Engineers' Incitation Club against the Union Electric Light & Power Company of St. Louis. Where an electric utility in successful operation in a large community has a value above that of its depreciated physical property, going value is not to be estimated on the accrued deficits of past operation, as losses do not constitute value. Apportionment of the value of conduits and manholes in partial use on the ratio of duct feet occupied to total duct feet of system is preferable to a total trench length percentage where the use of the trench is not exclusive. While due consideration should be accorded all evidence submitted on cost of reproduction as of date of valuation, actual prices, when available, paid for portions of public utility property, except land, and, when not available, unit prices as of the date of construction, or average normal unit prices, are deemed to possess greater weight. Where investment is not accurately disclosed by the books and records an approximate estimate of original cost would seem to be as reliable and perhaps more enlightening than estimates of reproduction under normal conditions or as of the date of the valuation.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Liability for Overflowing of Reservoir.—The owner of an artificial reservoir in no way constituting a nuisance, having been negligent in no respect, is not liable, according to a decision of the Supreme Court of California, for injury to land below by the breaking out of waters through an extraordinary and unprecedented flood. (186 P. 766.)

Constitutionality of Law Governing Flowage Rights.—The Supreme Court of New Hampshire has held that a statute of 1919 providing that public utilities can acquire lands, flowage rights and easements by paying the owner therefor is not unconstitutional as taking property without due process of law, or because under a previous flowage act owners are given compensation and 50 per cent additional, or because it constitutes "class legislation." (108 A. 813.)

Procedure as to Hearings and Evidence Before Commission.—The statutes creating the Railroad Commission of Georgia and giving it power over public service corporations do not, it has been declared by the Georgia Supreme Court, in City of Atlanta vs. Georgia Railway & Power Company, require the commission to afford a hearing in the exercise of its rate-making function, and where in such exercise the commission considers a document on file with it as to the value of the property of a company for which rates are to be prescribed, without formally introducing such document in evidence at a hearing, this will not be sufficient ground for setting aside as void the order of the commission prescribing rates. (100 S. E. 442.)

Powers of Town's Selectmen—Implied Promise to Pay.—In finding against the Van Buren Light & Power Company, which sued the inhabitants of Van Buren, Me., for payment for street lighting under an express or implied contract, the Supreme Judicial Court of Maine held that, the light company's charter limiting the right of a town contracting with it to contract only by the town's selectmen, a contract not merely executed but also negotiated by a committee of persons not selectmen was not binding on the town; furthermore, the court held that, the town having refused payment for nearly a year and the streets having thereafter been lighted by another electric plant, there could, subsequent to such refusal, be no implied promise to pay for lighting from the duplicate system maintained by the plaintiff, evidently without the consent of the town officers. (109 A. 4.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Harold K. Munroe, assistant superintendent of power, Stone & Webster companies, Tacoma, Wash., has resigned to become vice-president of the Continental Pipe Manufacturing Company, Seattle, Wash.

Arden B. Holcomb has been appointed general industrial engineer of Crippen & Funk, Youngstown, Ohio. Mr. Holcomb was formerly sales manager of the Moloney Electric Company, St. Louis, and before that was for many years connected with the Frank Adams Electric Company, St. Louis.

Edward L. Sherwood, who has been appointed assistant secretary of the Illuminating Engineering Society in charge of work at headquarters, served during the war as commanding officer of the artillery tractor experimental shop, Ordnance Department, at Detroit, Mich. During the period 1903-1913 he was in the employ of the General Electric Company, first on tests and later as sales engineer. In 1908 he organized the San Francisco district office of the

E. L. SHERWOOD

Edison Lamp Works, and in 1909 he was appointed district manager at Cincinnati. He resigned in 1914 to become production manager of the Abbott Motor Car Company, Detroit, Mich. A few months before joining the army he was made manager of the New York branch.

Dr. Albert C. Crehore, a well-known physicist and joint author with Professor Bedell of the college textbook "Alternating Currents," has accepted a position with the Nela Research Laboratories at Nela Park, Cleveland, Ohio. Dr. Crehore will devote his time to furthering his investigations on physical and electrical subjects.

Arthur E. Fitz, an electrical and research engineer formerly with the Connecticut Telephone & Electric Company of Meriden, Conn., has resigned from that company because of ill health and has gone to Terryville, Conn., to recuperate. Mr. Fitz joined the staff of the Connecticut Telephone & Electric Company in 1917 and was made engineer of the material and research division of the company in 1919.

B. F. Snow, formerly of the Portland office of the Pacific Power & Light Company, has been appointed manager of the Hood River (Ore.) office to succeed J. E. Law, who has resigned.

Jacob Augsberger, for ten years chief engineer of the Cannon Falls (Minn.) hydro-electric plant of the Northern States Power Company, died recently from pneumonia following influenza.

Frank H. Golding has resigned as general manager of the Central Power Company, Canton, Ohio, to become local sales manager for the Holmes Automobile Company. Mr. Holmes was formerly manager of the electric light companies at Rockford, Ill., and Atlantic City, N. J.

O. G. F. Markhus, who for many years has held the position of general superintendent of the Idaho Power Company at Boise City, Idaho, has resigned to take up the duties of general manager of the Boise Artesian Hot & Cold Water Company. R. D. King, manager of the Twin Falls division, will succeed Mr. Markhus as superintendent of the company.

Alexander Taylor, for many years manager of works with the Westinghouse Electric & Manufacturing Company, has been made assistant to the vice-president in general charge in all plants of production, stocks and stores. R. L. Wilson has been promoted from the position of general superintendent to be works manager of the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company. E. R. Norris has been appointed director of works equipment in charge of machinery, tools and methods in the various plants.

Charles D. Fawcett, who has recently been appointed assistant professor of electrical engineering at the University of Pennsylvania, was graduated from the University of Colorado in 1911. He then served as instructor at that institution for one year. For two years he worked in the testing department of the General Electric Company and also in the research section of the transformer department. Later he served for several years as instructor in electrical engineering at the University of Pennsylvania, and in 1916 he was appointed assistant secretary of the Illuminating Engineering Society with headquarters in New York. During the war Professor Fawcett served as illuminating engineer for Monks & Johnson, and in this capacity he designed lighting systems for shipyard buildings and ways. Subsequently he was the authorized representative of the Emergency Fleet Corporation in charge of the construction and operation of the ship steel-fabricating plants at Pottstown and Leetsdale, Pa. Upon the completion of the steel fabricating work he resigned to accept his present position at the University of Pennsylvania.

S. J. Lisberger, engineer of the San Francisco district of the Pacific Gas & Electric Company, is now preparing as chairman of the California Utilization Code committee to submit to the Industrial Accident Commission the revision of the old code which has been in effect for some time. The revised code represents the best thought of the leading engineers, contractors and manufacturers of the state. Mr. Lisberger is chairman of the California line code committee, which is preparing a code to cover overhead-line construction adaptable to conditions in that state. He was born in Danville, Va., in 1881 and received the degree of B. S. in E. E. and master's degree in E. E.

S. J. LISBERGER

from the University of Wisconsin. During the year 1903 Mr. Lisberger was connected with the San Antonio (Tex.) Gas, Electric & Traction Company. Since 1904 he has been in the employ of the Pacific Gas & Electric Company, San Francisco, Cal., in the positions of electrical designer, engineer of distribution and engineer for the San Francisco district. In the latter position he has complete charge of all the electric properties in the city—generating stations, substations, distribution lines and transmission lines, and steam heating. One of the particular engineering accomplishments of these years was the laying of two submarine cables across the Golden Gate. These are each 13,250 ft. long, are laid at a maximum depth of 215 ft., and operate at 11,000 volts. Mr. Lisberger during the last few years has served on the engineering committee, Pacific Coast Section, N. E. L. A., and the overhead line and apparatus committees, N. E. L. A., being district chairman of the latter. He has also been Western representative before the Bureau of Standards, Washington, on the investigation concerning the national line code.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Motors to Be Standardized for Washing Machines

ADDITIONAL washing-machine wringers and rolls are now being supplied so rapidly that members of the American Washing Machine Association, assembled in Chicago on March 17 and 18, expected their limiting production factor to be changed from wringers to motors in a very short time. It was therefore deemed necessary for the association to do everything in its power to promote the increased output of fractional-horsepower motors. With this end in view a committee was appointed, under the chairmanship of Howard Power of Davenport, Iowa, and with R. D. Hunt, Fairfield, Iowa, and Walter Conlon, Chicago, as members, to draw up specifications for one standard motor which could be used on all washing machines.

The net result of the change in the wringer situation has been to ease up delivery somewhat, principally by the securing of better distribution of wringers to the industry. Deliveries, however, are not by any means good and are being held back considerably by traffic conditions. About 50 per cent of the wringers come from New England, where a recent blizzard tied up traffic, and the congestion in Pittsburgh, Buffalo and Chicago makes it difficult to get parts and raw materials.

Electrical Manufacturers Feel Malleable Shortage

MANUFACTURERS of electrical apparatus and supplies who use malleable iron in their product are hard put to it in many cases to obtain sufficient quantities of this material to keep up their production. According to the American Malleable Castings Association, the foundry capacity is ample to provide for all the known demand, which is now probably considerably in excess of the nation's normal needs. It is believed that manufacturers at present in the malleable business certainly could take care of the demand if shop and molding capacity were the only consideration. Consequently it is not a question of adding more foundry capacity.

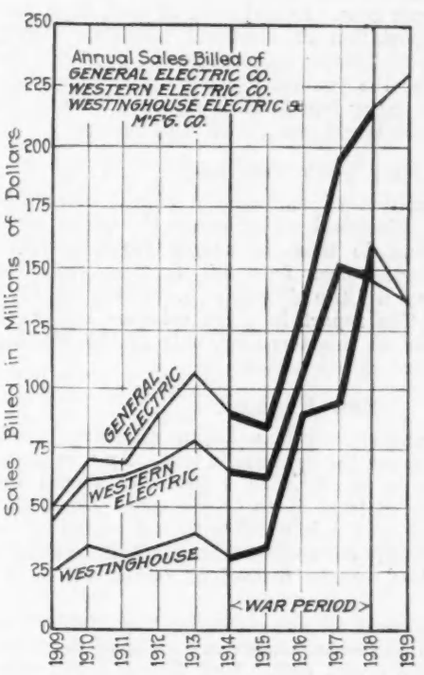
The whole trouble seems to be the scarcity of labor, and it is hardly expected that this condition can readjust itself in a short time. Rather skilled labor is employed in the foundries, and it is there that the shortage exists. It can readily be seen that there is no opportunity of running extra shifts where there are not enough molders to man existing capacity in a single shift.

Electrical manufacturers are not getting all the malleables they have ordered. One manufacturer has had to close part of his shop because of this shortage. Another is allotting his malleable products to from 20 to 50 per cent of each order. One item which is running short is the connector for flexible armored conductor. Brass and bronze, sometimes galvanized, are being used as substitutes at an increase in cost of only 2 or 3 cents above malleable prices. This latter material has advanced to a present price of $43.65 per ton delivered Pittsburgh, which is about $12 a ton higher than a year ago.

Certain malleable companies are not able to take care of their regular customers, much less supply any new customers. Reorders from regular customers, where the old molds are still available in the foundry, are being shipped in four to six weeks. Where foundries have capacity and labor to take on new business shipments are being made in about three months. Normal shipments on reorders are two to three weeks and on new customers' orders from five to six weeks. Where drop forgings are being substituted for malleables shipments are as bad as for the malleables. Extremely heavy demand for malleables from the automobile trade, which is willing to pay premiums to secure deliveries, is taking much of the foundry capacity which could be applied to electrical needs.

Three Largest Distributers' 1919 Sales Total $500,000,000

THROUGH figures which have just become available it is shown that the business of the three largest electrical manufacturers—the General Electric Company, the Westinghouse Electric & Manufacturing Company and the Western Electric Company—for the calendar year 1919 will amount to a total of approximately $500,000,000.



ELEVEN YEARS' SALES RECORD FOR THREE DISTRIBUTERS

The figures of the Westinghouse company are the result of an estimate for the calendar year, as the fiscal year of that company ended March 31. This total figure is less than that for 1918 by just over $22,000,000, which is undoubtedly accounted for by the lessened government requirements following the cessation of the war. On the other hand, commercial requirements in the electrical field at this time are still considerably above the trend of the curves showing the demand over the six years previous to the war. The General Electric Company did the biggest business in its history in 1919 and surpassed in sales all other electrical manufacturing companies. Its volume amounted to $230,000,000, or approximately $13,000,000 over that of 1918. Sales of the Westinghouse company show a decline of $26,000,000, with an estimated 1919 calendar year volume of $134,000,000. Western Electric's sales also declined to $135,722,000 from the 1918 volume of $145,226,000. In the case of Western Electric there was an increase of $6,330,000 in total sales for 1919 if government business be excluded.

Total unfilled orders of the three companies amounted to $215,000,000 on Dec. 31, 1919, which shows an increase of $42,500,000 over the figures of the previous year. Gen-

eral Electric's unfilled orders amounted to $100,000,000, those of Westinghouse Electric to $68,000,000 and Western's to $47,442,000. From the first of the present year unfilled orders have been increasing. A careful survey of Western's prospects for the year 1920 indicates a much larger volume of sales than in any previous year of the company's history, according to its annual report. General Electric's business is now running at the rate of $28,000,000 a month.

Early in 1919 the volume of sales fell off materially and prices of much electrical equipment declined. Before the middle of the year, however, business had picked up appreciably and prices started to rise, until during the last half of the year sales were being made in unprecedented volume at constantly increasing prices. It is reasonable to expect, therefore, that the sales of the Westinghouse company, taken over its fiscal year ended March 31, 1920, will exceed those of the estimated figure of $134,000,000 for the calendar year by possibly five or ten million dollars.

Lengthening Collections Cause More Care in Credits

IN VIRTUALLY every section of the country collections in the electrical industry are not in such good condition as they were at the first of the year. There has been no radical falling off in the situation, but just enough lengthening of collection time to cause the trade to exercise considerable care in financial matters. Money is not so free as it was and in some cases is tight. Call money is high. Early this week call money in New York was 12 per cent, following a renewal rate of 8 per cent. Time money is 8 to 8½ per cent. Actual need of cash, high loan rates, poor transportation of electrical materials during January, February and March and income-tax payments are given as causes for the general slowing up of collections. At the same time, many houses have reported little or no change. The outlook is not considered to be serious.

New York Territory

No general condition of appreciably longer collections has been found. Electrical manufacturers' reports show more optimism than do those of supply jobbers. Little change in collections comes from the former, while the jobbers are having a little difficulty in getting in their money on time. The report in these columns last week covers the situation in this territory, only at this writing in a way still better substantiated.

New England

Collections in general have been falling off since Jan. 1, although in a few cases the opposite is true. As a rule, the total bills receivable as of April 1 probably exceed the figure of Jan. 1 by at least 30 to 40 per cent. Conditions are spotty, however, and it is possible to find an individual jobber who has actually cut $60,000 from his bills receivable during the past two months instead of falling off in his receipts.

Shortage of materials all along the line from factory to consumer is the most serious underlying cause of the present situation in the credit field. New England was very hard hit by the severe weather of the past winter, and freight and express embargoes combined with traffic tie-ups to check and sometimes completely to stall deliveries. Excessive taxation has hurt payments, but impaired deliveries are the most potent factor in retarding collections at present. The discounting of bills is probably decreasing in the main. Considerable difference of opinion exists in regard to the value of the acceptance method, but one jobber who reports individual record collections last week of from $8,000 to $10,000 per day attributes much of his success in expanding remittances to this practice.

There is no question that the jobbers are helping many contractor-dealers to tide over a very disturbed period at this time resulting chiefly from material scarcity and consequent interruption of field work and curtailed financial returns from the ultimate consumer. Considerable effort is being made to secure payments within sixty days of billing where the ordinary methods of negotiation are followed. Now and then time is extended to ninety and even 120 days, but in the main collections and credits are being scrutinized more closely than for some time, and the restrictions being placed by the banks upon loans for speculative purposes are influencing the attitude of both wholesalers and retailers toward more conservative views. Competent observers in the main decry any pessimistic attitude in regard to collections as spring advances and see in underlying conditions the likelihood of improvement during April or May.

The Middle West

Credit is being extended as freely as ever in the Middle West, but for steadily decreasing periods of time. For instance, one electrical apparatus manufacturer said: "Customers to whom we have been in the habit of giving ninety days we have reduced to sixty days; those who have been accommodated for sixty days are now asked to pay in thirty days, and regular thirty-day accounts must now be paid within ten days." Another manufacturer, who makes socket devices, has been in the habit of allowing 2 per cent discount for cash in thirty days, but he is now billing less 2 per cent ten days, thirty days net, and is insisting on prompt payment.

A representative jobber operating out of more than one Middle West city is now collecting, on an average, in forty-eight days against fifty-two days in March, 1919, and thirty-seven to thirty-eight days last fall. This and other jobbers in the territory are now requiring their customers to pay more promptly. The same condition is noted in retail business where the electrical contractor-dealers are using every effort to reduce the time allowed in the payment for washing machines and other time-payment devices.

The shorter time requirements of sellers were not apparently inspired by any fear of the customers' ability to pay. It was because of the actual need of the cash in most instances. The raw-material people have shortened up on the electrical manufacturers, and the strongest companies borrowing in large amounts have to pay in excess of 7 per cent for money with which to discount their bills. To mention just one raw material, steel, it can be said that some of the steel manufacturers require cash in ten days; some attach a sight draft to the bill of lading, and a few require a cash prepayment of 50 per cent of the amount of the order before proceeding to roll the steel required.

The South

Business conditions continue fundamentally sound throughout the section. Bank clearings show an increase from 20 per cent to 40 per cent over the same period last year, and a general optimism prevails that the slowing down in collections is only temporary, the fundamental causes being, first, that at this season of the year large sums of money are required by the rural population to finance agricultural operations, thus causing a tightening up of bank credits to commercial houses; second, that heavy December accounts, payable in thirty to sixty days, have caused drains on contractors' available funds; third, that income-tax payments for which no reserve was set aside have further depleted their cash assets; fourth, that transportation difficulties have slowed up collections all down the line, from the small contractor to the manufacturer.

One representative jobbing house finds no appreciable change in collections within the past sixty days, and cash discount customers have continued as usual. Other houses report increases of from 15 to 25 per cent in past-due accounts over the past few weeks. Their large customers are taking cash discounts only when these are amounting to 2½ to 5 per cent.

West Coast

Although other parts of the country are complaining over credit and collection conditions, they are not very different on the Pacific Coast from what they were several months ago. They are satisfactory rather than otherwise. The average time for collections is about fifty days, and although the income-tax payments may have slowed them up, the optimism resulting from the welcome and despaired-of rains more than balanced this.

Increases and Decreases Shown in New Mazda Lamp Prices

NEW lamp prices have been put into effect by the Mazda lamp manufacturers as of April 1. These prices do not in all cases show an advance and some show a decrease. Increased cost of production has been given by the manufacturers as the reason for the advances, and in this connection greater advances have been placed on frosted lamps than on clear lamps. Complications in the sand blasting have made this process still more costly. The last increase was put into effect Oct. 1, 1918.

In the common run of lamps in the 110-volt to 125-volt type the 10, 15, 25, 40 and 50-watt Mazda B lamps have increased from 35 cents to 40 cents clear and from 38 cents to 45 cents frosted. The 60-watt B has increased from 40 cents to 45 cents clear and from 45 to 50 cents frosted.

Type C lamps show increases and decreases. The 75-watt has gone from 70 cents to 75 cents clear and from 75 cents to 80 cents frosted. No change in price has been applied to the clear types in the 100, 750 and 1,000-watt sizes, but frosted lamps have gone up respectively in these three sizes from $1.15 to $1.20, from $6.75 to $6.85 and from $7.75 to $7.90. On the other hand, the 150-watt C has decreased from $1.65 to $1.55 clear and from $1.70 to $1.65 frosted, the 200-watt from $2.20 to $2.10 clear and from $2.27 to $2.25 frosted. The 300-watt has decreased from $3.25 to $3.15 clear and the 500-watt from $4.70 to $4.60 clear, while their prices, frosted, have not changed.

In addition, advances have been applied to 110-volt mill-type frosted lamps, 250-volt mill-type clear and frosted, 250-volt Mazda B clear and frosted, 250-volt Mazda C frosted and round lamps, tubular lamps, sign lamps, street-railway lamps, frosted Mazda C street series lamps and to other special types.

Metal Market Situation

COPPER continues strong in a market of considerable activity. Most consumers' present needs are pretty well cared for, and there is a lot of interest among them for long delivery. Producers, on the other hand, are not so anxious for positions after June. The spot and nearby price is 19 cents a pound delivered. Some producers have cut this an eighth and even a quarter in a few instances. There is strength also in the outside market, where nearby price is 19.25 cents, but there were not many sales with the seconds asking this price.

Copper wire, net, at the mill is up a half cent to 23 cents, and the copper scraps are also up the same amount to 16.50 to 17 cents. The scrap brasses, too, are up a quarter to a half cent.

There is a freer offering of nearby lead, and sales are being made at a fraction under 9 cents New York, although the first market is still quoted at 9.25 cents.

April zinc is moving better, especially with respect to brass special. This nearby offering is more active than futures.

NEW YORK METAL MARKET PRICES

	March 24	March 31
Copper	£ s d	£ s d
London, standard spot	108 0 0	107 10 0
	Cents per Pound	Cents per Pound
Prime Lake	19.25	19.25
Electrolytic	18.75	19.00
Casting	18.37½	18.50
Wire base	22.50	23.00
Lead, trust price	8.85 to 9.15	8.90
Antimony	10.75	10.50
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Spelter, spot	8.85	8.80
Tin	60.75 to 61.25	62.50 to 63.00
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.00 to 16.50	16.50 to 17.00
Brass, heavy	10.00 to 10.25	10.25 to 10.50
Brass, light	8.50 to 9.00	9.00 to 9.25
Lead, heavy	7.75 to 8.00	7.75 to 7.87½
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

ORDERS are pouring into jobbing houses from all directions, with the activity more pronounced in New England and in the Southern states than in other localities. Conditions of labor, which have held up much new building and remodeling work in New York, are much improved owing to the decision of the bricklayers and masons to return to work after being out on strike since the first of the year. Spring construction work is being started in the Chicago district, where building permits for the week total $3,000,000. Stocks are in poor shape in the Northwest and much construction has been started that may be held up unless shipments of needed materials are received.

Transportation terminals are rushed to clear up accumulations of shipments or of freight received. It generally is believed that deliveries are slightly improved.

Price changes have been made on incandescent lamps; the increases vary from 5 to 15 cents, while prices on a few large sizes are down.

NEW YORK

Sales of electrical supplies have fallen off slightly during the past week in the city, although increased sales are reported in the outlying sections of the metropolitan district on account of suburban building. Little was done on private buildings during the first two weeks of March, but since that time the demand has improved.

Improved weather conditions, coincident with the ending of the strike of the bricklayers and masons, are responsible for an increase in sales due to the number of remodeling jobs being started during the past week. New building work has been scarce in the city proper.

Although delivery conditions are much better than during the recent bad weather on certain lines, in general the improvement has been so slight that many jobbers are inclined to believe that, in addition to a car shortage, decreased production during the storm period, owing to raw material shortage, is to a great extent responsible for the small amount of material being received at this time.

Some conduit and flexible armored conductor is coming in, but the amount is so small that it will not have an appreciable effect on the market. Prices have been advanced on several makes of push-button switches.

Rigid Conduit.—Conditions about the same as usual, small amounts being received with majority of stocks cleaned out.

Flexible Armored Conductor.—Shipments are improved but stocks are reshipped as soon as received. No stock on hand is reported by the majority of jobbers. Prices for No. 14 double-strip are $98 per 1,000 ft. for whatever amount jobbers will release. Small quantities are sold at from $110 to $120 per 1,000 ft.

Switches.—Push-button switches manufactured by Bryant, Hubbell, Hart & Hegeman and Seymour have advanced from 31 to 35 cents for single-pole and from 42 to 52 cents for the three-point type.

Fans.—Demand for fans is increasing. Good stocks are being received, but are taken up promptly by dealers. Heavy ordering of the 16-in. size is reported.

Lamps.—Stocks are good in the smaller wattage lamps, but in the larger sizes many jobbers are entirely out. The 100-watt size is particularly scarce, and demand is many times greater than the supply. Shortages and spotty stocks also prevail in the 75-watt, 200-watt and 300-watt sizes.

Batteries.—Stimulated buying has marked the past week, many dealers being in the market for stocks. Shipments are slightly improved.

Vacuum Cleaners.—Business continues good, although in a few instances shortages are reported on attachments. One jobber is short 460 sets of attachments and others advise that attachments are coming in very slowly.

Heaters.—Some jobbers are cleaned out of stocks, while others have small amounts. Increased buying is expected as landlords turn off furnace heat in the spring.

BOSTON

Orders continue to pour in faster than they can be absorbed. Prices are firm, with advances on common sizes of tungsten lamps effective April 1. Stocks are spotty, but deliveries are improving materially as traffic recovers from the effect of bad weather. Severe shortages are still being experienced in porcelain, steel, motors and loom. Collections are less satisfactory, barring exceptional cases. Labor-saving appliances are in great demand and record sales are being made. Central stations are beginning to come into the market for pole-line material. Business is much disturbed in lower New England by dissymetrical policies regarding daylight saving, but the situation is expected to clear during the week. With better weather, up-country sales work shows considerable improvement from the jobbing standpoint.

Lamps.—Prices advanced April 1 from 35 to 40 cents list on 10-watt to 50-watt tungsten lamps, accompanied by recessions of about 5 per cent on the list price of some of the larger-wattage gas-filled lamps. The demand for lamps is enormous, and some jobbers are unable to obtain satisfactory deliveries. Sign lamps and miniatures are reported plentiful in supply.

Transformers.—Some jobbers are doing a land-office business. Central-station patronage is increasing.

Wire.—Stocks are fairly good, but a shortage of No. 14 rubber-covered wire is reported in Connecticut. This size and type is quoted at $11.50 per thousand in 5,000-ft. lots and $13 for lesser quantities. Weatherproof base ranges from 28 to 30 cents according to quantity. Bare wire is firmer at 24 cents base. Labor troubles in the lower Naugatuck Valley may hamper production somewhat unless soon settled.

Magnet Wire.—This is extremely scarce. One concern in New England has refused orders for over $2,000,000 worth of this material since Jan. 1 and recently purchased silk for insulation at about $31 per pound. The shortage is so great that prices are very unstable.

Flexible Armored Conductor.—Stocks are very low. A representative quotation is $105 for No. 14 single-strip per 1,000 ft., in coil to 1,000-ft. lots.

Non-Metallic Flexible Conduit.—Jobbers cannot begin to meet the demand satisfactorily. The ½-in. size brings $37 per 1,000 ft., and the ¼-in. size, $40 to $42.

Metallic Flexible Conduit.—Prices have been withdrawn on account of scarcity.

Lamp Cord.—Cotton-covered cord is hard to obtain. The ordinary No. 10 cord is quoted at $43.70 per 1,000 ft. with discounts running up to 45 per cent for 5,000-ft. lots.

Sockets.—Deliveries are better than usual at this time of year. Stocks are not building up much, but current demands are being met with reasonable satisfaction. In case lots pulls are quoted at 47.5 cents net, keys at 28 and keyless at 26 cents each.

Vacuum Cleaners.—Trade is brisk, with good deliveries. A leading outfit sells to the contractor-dealer for $39, or $46 including attachments, in half-dozen lots.

Washing Machines.—Steady sales characterize the market, and so far the supply meets the demand exceptionally well.

Fans.—Orders are being placed by retailers. Few fans have as yet come to hand, but shipments cannot long be delayed.

Ranges.—Interest in electric ranges is being manifested by the public notwithstanding earlier price advances. The shortage of material is holding back development work in some manufacturing quarters.

CHICAGO

A spirit of questioning the stability of the sum total of orders on books is now beginning to be felt among both jobbers and manufacturers of all classes of equipment. Unquestionably, in order to secure the earliest possible shipment of goods, a certain amount of duplication of orders has occurred. The question is to what extent this duplication exists. The placing of all orders on contract, not subject to cancellation, is being considered by some manufacturers.

No appreciable change in general conditions can be noted, with the exception that buying pressure is probably a little less feverish.. Deliveries are unchanged, simply because they have for some time been about as bad as possible. Manufacturers of all lines complain of raw-material shortage, and makers of hollow ware state that, in addition to being forced to pay excessive prices for steel, they frequently get material of such inferior grade that much expense is necessary in finishing. This also increases the time required in process and further delays deliveries.

Spring construction work seems to be getting fairly under way here, with building permits for the week totaling over $3,000,000.

Industrial Controller Apparatus.—As predicted in this column some time ago, manufacturers of both resistance-wire type and carbon-pile resistor-type equipment have put into effect a general increase approximating 10 per cent. Demand is reported as heavy with deliveries ranging around thirty days.

Protective Apparatus.—With steady demand remaining in excess of production, an advance of about 15 per cent has gone into effect on lightning arresters and other protection equipment. A typical change is that of the Gorton & Daniels line, on which discounts which were formerly 32 per cent have been reduced to 20 per cent, an increase of 17½ per cent.

Circuit Breakers.—Price changes amounting to a sharp increase are reported on circuit breakers, the Cutter Electric & Manufacturing Company having issued new lists and at the same time announced a change in discounts. Their 100-amp., single-pole circuit breaker, formerly priced at $25, is now $42, while an additional 10 per cent discount is given, with similar changes in the entire line. This amounts to an approximate 50 per cent increase.

Meters.—Both Weston and Bristol lines have been subject to recent changes in discount. Weston meters, formerly sold at plus 25 per cent, are now priced to jobbers at plus 35 per cent, and Bristol, previously selling at list, are now plus 10 per cent. Demand in this section is not particularly heavy and deliveries are being made on about thirty to sixty days.

Insulators.—Glass insulators have followed the lead of all other pole-line material in advancing about 11 per cent.

Rigid Conduit.—Delivery conditions show but slight improvement and back orders continue to accumulate. Current list on black conduit in 2,500-lb. lots is, for ½-in., $82.88 per 1,000 ft.; for ¾-in., $109.83.

Farm-Lighting Plants.—Factory output is not at present keeping pace with orders, although jobbers are still able to make deliveries from stock. It is thought that factory additions now under construction will be completed in time to prevent any lengthy delay in deliveries. The Western Electric Company has withdrawn its fifty-hour battery equipment from sale.

Washing Machines.—Dealers are unable to secure machines as rapidly as they desire, and price advances seem to have no effect on volume of sales.

Sewing Machines.—Factories are not keeping pace with orders and in some cases have required jobbers to place contracts covering nine months' needs without cancellation privilege. Western Electric's machines advanced to the following figures on April 1: No. 1, vibrating shuttle type, $60; No. 2, rotary, $80; No. 3, automatic, $86.50, and No. 4, two-spool rotary, $90. Deliveries range from prompt to thirty days.

ATLANTA

With the advent of spring jobbers report the receipt of large increases in orders for all lines of electrical material, while requests for estimates and bids on material required in the near future are reaching unprecedented proportions. Most of these requests are for industrial plant material, but there is a noticeable increase of requests from contractors whose work is devoted largely to the wiring of homes and small commercial houses. Inability of jobbing houses to make the prompt shipments required for the large industrial orders is causing dissatisfaction and a resultant slowing up in the completion of the electrical work.

Strong demand for office and manufacturing space and housing facilities is stimulating calls for construction even in the face of rising prices. Building permits in Atlanta for March already have exceeded the six-hundred-thousand-dollar mark.

While bank clearings continue to show a gain over the same period of last year, some jobbers report that collections are not all that might be desired.

Generating Equipment.—There is a healthy demand from municipalities and small utilities for turbo-generator sets up to 1,500 kw., while the engine-driven alternators continue to move satisfactorily. Demand for the latter article is mostly in sizes of from 30 kva. to 250 kva., three-phase, 60-cycle. Shipments on small turbo-generators are approximately six months.

Conduit.—Electric construction work is suffering from the acute shortage in this item. Only small shipments are received from time to time, and these are entirely insufficient to meet the demand. Prices, if in stock, less than 2,500 lb., black, ½-in., $87.20; 1-in., $177.40; 2-in., $392.20.

Flexible Armored Conductor.—No change is noted. Prices remain steady in the face of the continued shortage, while no hopes of improvement are held out by the jobbing trade.

Sewing Machines.—As predicted, sewing-machine prices advanced 20 per cent as of April 1. Some jobbers have fair stocks on hand, sufficient in their estimation to take care of the demand for the time being at least. Shipments are reported fair.

Wire.—Average supply of weatherproof is not so good as last week. The rubber-covered stocks continue to hold up well. The greatest difficulty is in obtaining the popular sizes of weatherproof, in which sizes deliveries are reported as poor. Price advance of 8 per cent is reported on rubber-covered.

Mangles.—The success attending the use of the large number of washing machines throughout the territory has served to create a brisk demand for the electrically operated mangle. Stocks are moving fairly well, and jobbers report shipments as above the average.

Electric Churns.—The growing popularity of this specialty is to be noted, particularly in the rural districts where farm-lighting outfits are in use. Stocks are good, despite poor factory shipments.

Dry Batteries.—National advertising is probably responsible for the demand continuing to hold up in what is normally a light season. Stocks are reported as only fair and shipments not sufficiently good to permit of the accumulation of heavy supplies for fall trade. Prices, in quantities of from 50 to 125, $38 per 100.

Battery-Charging Outfits.—Starting batteries on the large number of automobiles throughout the section provide an insistent demand for these outfits. Jobbers report a satisfactory turnover, while shipments continue to hold up fairly well.

SEATTLE—PORTLAND

Demand for schedule materials used in building is being sustained. Fractional-horsepower motors and domestic appliances continue strong, and this condition is being met with unusually slow transportation and acute shortage of stocks along virtually every line. Without a doubt conditions as regards stocks in the Northwest are worse today than during the war, for then, in spite of the heavy demands, merchandise could be obtained on priority orders. In spite of this condition, prices are comparatively steady, the fluctuations either way being considered more or less inconsequential.

Marked activity is noted throughout the Northwest in various irrigation projects, both new and revived, and it is certain that a large amount of reclamation work in many districts will be commenced this season.

Jobbers in the Portland territory state that the unusually severe winter weather which has been experienced in the East practically ever since the first of the year is having a marked effect upon production and that this is being reflected in this section at the present time in the shape of decreased stocks and long promises for future deliveries. There have been no marked changes in sales or prices during the past week; in fact, there has been no change for the past five or six weeks that is of any marked importance. The retail trade reports that sales of small appliances are normal for this time of year and that there is a very strong demand for washing machines, even in face of the recent 10 to 15 per cent increase in price.

There are a large number of very large projects in view, but they are developing slowly, due undoubtedly to the uncertainty of the future.

Pole-line hardware, in face of a noticeable increasing demand to care for spring maintenance and some new work, has made an advance of approximately 20 per cent during the past ten days. In Seattle particularly stocks are low and deliveries very slow. The rigid-conduit situation is unimproved and demand is growing stronger each week. At present enough material can be obtained to care for remodeling, but new construction is being retarded. Efforts to replenish stocks apparently have been futile.

Sewing-Machine Motors.—Jobbers in both Seattle and Tacoma report an increasing call for special bracket motors. Stocks are low, but, owing to the recent arrival of fresh consignments, are in better condition than they were several weeks ago. Prices show no recent change.

Wire.—Stocks in the popular sizes show further decreases, and no hope of immediate betterment is cherished. The demand shows increases from week to week. Prices show no change over past few weeks.

SAN FRANCISCO

The chief Pacific Coast difficulty is lack of stock, and this trouble extends to merchandising as well as wiring lines. Household-device campaigns have been held up time and again by stock shortages, and several jobbers state that they are making virtually no new-business drives because of the difficulty in caring for their regular customers.

Freight shipments are requiring about four weeks from the factory, although an occasional carload goes astray. The reported 25 per cent increase in freight has not yet materialized. Get-together meetings of various sections of the California co-operative campaign are planned for April to review the exceedingly encouraging results from last year and plans for this year and for 1921.

Washing Machines.—Difficulties in the washing machine line are lack of stock and lack of experienced solicitors. Many dealers have viewed their prospective results too optimistically, but they now understand that experienced men are needed to get the public into their stores.

Sewing Machines.—Another advance in sewing machines is reported, this time of about 10 per cent, raising the retail price on the vibrating style to $62 each in standard makes. Sewing machine sales have dropped.

Line Material.—Many sales of line construction tools are reported. Jobbers are purchasing in carload lots because of this increased demand.

Fixtures.—Hand-in-hand with the improvement in merchandising household devices has come a better method of displaying and selling electrical fixtures. Higher-grade fixtures have replaced the old familiar gilt affairs, and dealers are meeting the increased call for artistic portables with silk or parchment shades.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

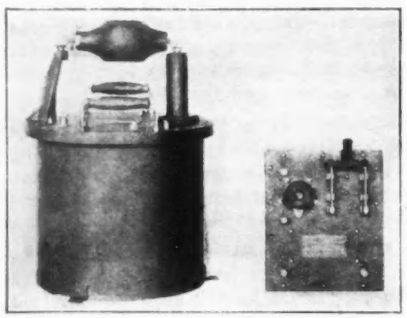
Two-Point Electric Flatiron

A 6-lb., double-point electric flatiron, with two hot points instead of one so that the operator can iron with the backward and forward movements of the iron, is being offered by the Central Flatiron Manufacturing Company, Johnson City, N. Y. This double point will protect the switch plug, the maker says, should the iron be dropped from the ironing board.

FLATIRON HAS TWO POINTS

Portable Oil Tester

A small, compact, portable oil-testing set has recently been developed by the General Electric Company, Schenectady, N. Y. The set consists of a main testing transformer having a high-potential winding for 25,000 volts, a control auto-transformer and an oil-testing spark gap. It may be had for operation at 110 or 220 volts, 60 or 25 cycles as specified. The oil-insulated testing transformer has a steel tank with composition cover. The control consists of an air-cooled auto-transformer with regulating taps, connected to a selector switch with a dial to give 15, 17.5, 20, 22.5 and 25 kv. on the high-tension winding of the main transformer and a double-pole step-resistance knife switch, all mounted as a unit. The oil-testing spark gap consists of a hard-rubber body molded in one piece with 1-in. disk electrodes. One electrode is movable by rotating and a gage is provided for adjusting the spacing to ½ in.

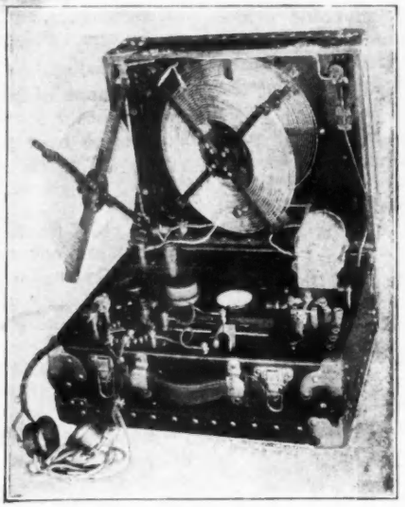


PORTABLE SET GIVES 25,000 VOLTS FOR OIL TESTING

Light-Weight Portable Radio Set

The Wireless Specialty Apparatus Company, Boston, is marketing a portable radio set weighing 55 lb. and measuring, closed, 10 in. x 15 in. x 17 in. It is said to have a transmission range of 50 to 100 miles and a receiving range of 500 miles. Designed to withstand heavy field service, its features include an improved quench gap, an ammeter, a closed-core transformer, mica condenser and silver-plated tuning coils.

The set can be assembled, it is claimed, in four minutes. A telescopic antenna pole, 40 ft. long, is provided separately and energy is supplied by a gasoline-engine-driven generator for either 32 volts or 110 volts. The generator weighs 130 lb. and is designed for packing on muleback.



WEIGHS ONLY 55 LB.

Insulating Porcelain

An insulating material made of native clays for use in the same manner as the better known white electrical porcelain has been developed by the Evansdale Clay Products Company, Wheeling, W. Va. This product is said to have all the characteristics of the common electrical porcelain except that it is dark instead of white.

Vacuum Tube Detector and Amplifier

A detector-amplifier and a two-stage amplifier for use at vacuum-tube frequencies have been developed by the International Radio Telegraph Company, New York City. These two units may be used in series.

Direct-Current Ceiling Fan

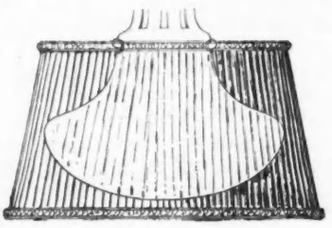
The Hunter Fan & Motor Company, 34 West Thirty-seventh Street, New York City, is offering for 1920 a new direct-current ceiling fan, patterned in appearance after its type "C" alternating-current line. This new line will be known as type "L" for the plain fan and type "LO" for the ornamental. The fans will be furnished either with or without the adjustable blade feature. They are finished in oxidized copper and are equipped with three-speed switches, maximum 215 r.p.m. and minimum 150 r.p.m. They are rated at 75 watts and are supplied for 110 volts or 220 volts.

Garage Air Compressor

An electric air compressor for inflating tires has been developed by the United States Air Compressor Company, Cleveland, Ohio.

Dust-Proof Lighting Units

A line of lighting units called "Caso-Lux" is being manufactured by the Cassidy Company, 14 Wilbur Avenue, Long Island City, N. Y. The units are of five types, in 12-in. to 15-in. sizes, for both pendent and ceiling use, for office, store and home. Each unit is designed so that dust cannot affect its reflecting surfaces, the maker says, and has been tested with a pyrometer to insure proper ventilation. Each fixture is wired complete with porcelain socket and packed in an individual carton.



DUST CANNOT SETTLE ON REFLECTOR

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, Mansfield, Ohio, is planning to increase its factory facilities materially this summer and to extend its standard line of machines to include also synchronous machines.

THE WESTINGHOUSE LAMP COMPANY has awarded contract for construction of an extension to its factory at Milwaukee, Wis., to cost about $400,000.

THE M. B. AUSTIN COMPANY, Chicago, announces that the Factory Mutuals Fire Insurance Companies have approved Trico renewable fuses in all capacities up to 60 amp., 250 volts.

THE ROME WIRE COMPANY, Rome, N. Y., has recently authorized an increase in capital stock to $4,000,000 7 per cent first preferred and $5,650,000 common, the shares in each issue being $100 par value. Kidder, Peabody & Company of New York and Boston are offering to the public $1,400,000 of the preferred issue. The proceeds of the sale of $1,400,000 of preferred stock will furnish additional working capital to care for the growth of the plant in Rome and to pay for plant and carry on the business of the Diamond branch of the Rome Wire Company in Buffalo, N. Y. The total quick assets of the company amount to $3,997,680, and the company's surplus is $2,033,118.

Company, has opened offices in the First Wisconsin National Bank Building, where he will represent electrical equipment manufacturers. He will cover Wisconsin and the upper peninsula of Michigan, and is in a position to take on a few more live lines.

W. JERRY STANTON has recently become connected with the Ohio Brass Company of Mansfield, Ohio. Mr. Stanton has been connected with the electrical industry for the past twenty years. He was with the General Electric Company for eighteen years, having served in the testing, engineering and sales department. Since that time he has been with the Railway Improvement Company and the National Railway & Appliance Company.

WESTERN ELECTRIC MANAGERS AND EXECUTIVES HOLD CONFERENCE.—Managers and sales managers of the Western Electric Company's distributing organization of forty-five houses and executives from the head offices at 195 Broadway, New York City, held the first general company conference in five years at the Hotel Chalfonte, Atlantic City, N. J., on March 8 to 12. F. A. Ketcham, general sales manager, acted as presiding officer of the conference. The keynote of the conference was "A Larger and More Profitable Business," and it early became apparent that the consensus of opinion was to the effect that this end could be attained. Optimism was the prevailing sentiment not only for the growth of the company's business but for the growth of the electrical industry as a whole.

in capital stock from $10,000 to $50,000 for expansion.

THE SEIFFERT ELECTRIC COMPANY, Evansville, Ind., has increased its capital stock from $30,000 to $100,000.

THE ELECTRIC CONSTRUCTION & MACHINERY COMPANY, Rock Island, Ill., manufacturer of electrical machinery, has increased its capital stock from $5,000 to $25,000.

THE REPUBLIC CARBON COMPANY, Milwaukee, Wis., has increased its capital stock from $2,500,000 to $5,000,000.

THE PERRY ROTARY FIXTURE COMPANY, Meridian, Miss., is planning to equip a plant for the manufacture of motor speed-changing devices.

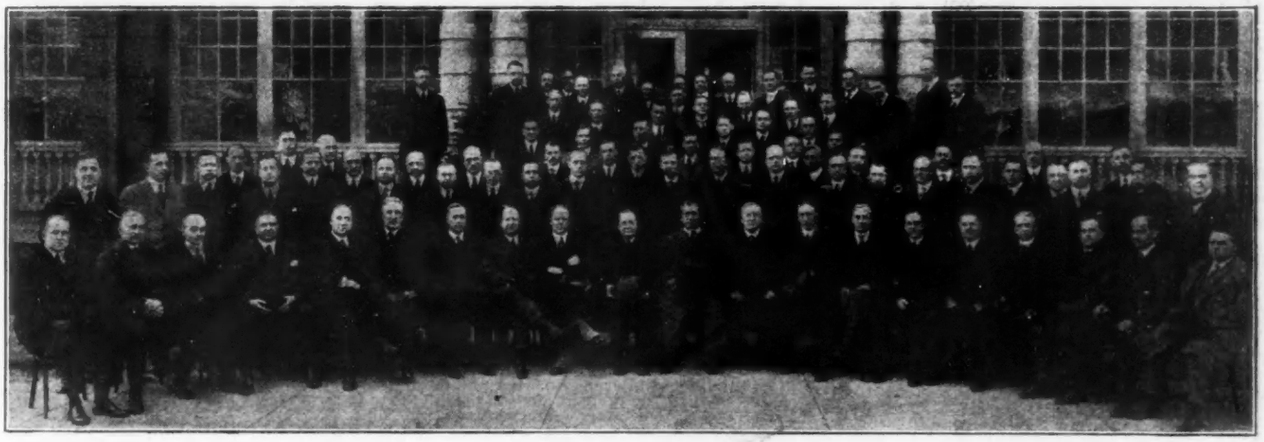
THE DICTAGRAPH COMPANY, Jamaica, N. Y., manufacturer of electrically operated devices, has awarded contract for a one-story addition, 50 ft. x 144 ft., to its plant at Schooley Place and Chichester Avenue.

THE MICA INSULATOR COMPANY, Schenectady, N. Y., has awarded contract for a new building, 50 ft. x 130 ft., four stories, and for a one-story addition to an existing building. The cost is estimated at about $125,000.

THE AMERICAN BOSCH MAGNETO CORPORATION, Springfield, Mass., has increased its capital stock to $2,500,000.

THE WHITE LILY MANUFACTURING COMPANY, Davenport, Iowa, manufacturer of electric washing machinery, has completed plans for the construction of a new plant on Rockingham Road, consisting of a main building, 80 ft. x 225 ft., and several smaller structures, to cost about $150,000.

THE CHAMPION ENGINEERING COMPANY, Kenton, Ohio, has made arrangements for extensions to its plant which will more than double the present capacity. The cost of the proposed addition is estimated at more than $1,000,000. It will be



WESTERN ELECTRIC MANAGERS' CONFERENCE AT ATLANTIC CITY

THE AMBER ELECTRICAL SUPPLY COMPANY, Chicago, has leased a two-story building, 40 ft. x 189 ft., at 553-55 West Madison Street for a period of ten years.

THE SERVICE STATION EQUIPMENT COMPANY, Chicago, has leased a three-story building, containing 60,000 sq.ft., at the corner of Thirty-seventh Street and South Asland Avenue. The company expects to erect an addition in the rear of the building.

THE WADSWORTH ELECTRIC MANUFACTURING COMPANY, Covington, Ky., has filed notice with the Secretary of State of an increase in capital stock from $100,000 to $150,000.

THE KENTUCKY-WEST VIRGINIA ENGINEERING & ELECTRIC COMPANY, Ashland, Ky., has been organized to do a general engineering construction business, utilizing an armature and machine shop and engaging in wholesale and retail sales of electric supplies. Thompson Pierce of Bluefield, W. Va., is president; C. Biddison of Ironton, Ohio, vice-president and R. F. Carpenter of Ashland, Ky., secretary and treasurer.

STANLEY L. POLACHECK, formerly with the Chas. Polacheck & Brother Company and later with the Milwaukee Electric

THE CHICAGO ELECTRICAL ENGINEERING COMPANY, Chicago, has established offices at 1,000 Diversy Parkway. The company will deal in electrical apparatus, particularly radio, telephone and telegraph equipment.

THE ROBERTSON SALES COMPANY of Birmingham, Ala., announces that the name of the company has been changed to the Robertson Supply Company, Inc. No change in the personnel or management of the company, it is understood, has been made.

THE DETROIT ELECTRICAL HEATER COMPANY, 1351 Woodward Avenue, Detroit, Mich., manufacturer of electric heating and cooking appliances, is planning to erect a two-story-and-basement plant, 30 ft. x 130 ft., on Conner Avenue, Hamtramck.

THE J. & M. ELECTRIC COMPANY, Utica, N. Y., has filed notice with the Secretary of State of an increase of capital stock from $100,000 to $200,000.

THE HOME ELECTRIC APPLIANCE COMPANY, Pittsburgh, Pa., a Delaware corporation, has filed notice of an increase

devoted exclusively to the manufacture of electrically driven traveling cranes.

THE MOE-BRIDGES COMPANY, Milwaukee, Wis., manufacturer of electric fixtures, has increased its capital stock from $40,000 to $100,000. The company contemplates the erection of a new plant during the spring and summer.

THE TRI-STATE ARMATURE WORKS, Memphis, Tenn., recently organized with a capital stock of $50,000, plans to establish a plant for the manufacture of electrical machinery and also to equip a repair department. W. S. Gaden is president.

THE JOHNSON ELECTRIC WASHER COMPANY, Emeryville, Cal., is planning to erect a plant, 120 ft. x 235 ft., to cost about $40,000.

THE COMMONWEALTH BATTERY COMPANY, INC., recently incorporated with a capital of $50,000, will manufacture plates for storage batteries at 17 Elm Street, Rochester, N. Y. The president and general manager is J. Harris of Rochester.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., in its annual statement for the year ended Dec. 31, 1919, shows net earnings for that year amounting to just over $4,800,000 and an accrued surplus to Dec. 31, 1919, of $13,347,214.

HERBERT RICE, who has been a member of the sales organization of the Cutter Electrical & Manufacturing Company and who has for some years past been its general sales manager, has resigned to enter the real estate business. Harry F. Darby, who was for many years in charge of the Cutter Company's Chicago office and who more recently has been sales manager of the Ward Electric Vehicle Company, will rejoin the Cutter organization as sales manager with headquarters in Philadelphia. These changes are effective about April first.

HORACE L. FRITSCHLE has been placed in charge of the Chicago office of the Square D Company at 431 South Dearborn Street, Chicago. Mr. Fritschle was formerly located in St. Louis.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, has announced the appointment of Godfrey H. Atkin as manager of its Western district, covering the sales offices, warehouses, service stations and all departments in Chicago, St. Louis, Kansas City, Minneapolis and Denver, with headquarters in Marquette Building, Chicago. Taliaferro Milton is in charge of the Chicago office, succeeding Mr. Atkin. Both appointments were effective March 1.

W. A. LODGE is now connected with the Bussmann Manufacturing Company, St. Louis, Mo., in the capacity of research engineer. He will be in full charge of the engineering department, devoting his time to research and the technical development of the Buss fuse. Mr. Lodge has for the past four years been with the Underwriters' Laboratories of Chicago as research engineer. Previous to his connection with the Underwriters' Laboratories, he was professor of electrical engineering in two universities in the United States and Canada.

NEW DIRECTORY OF COMMERCIAL ORGANIZATIONS. — A revised list of "Commercial and Industrial Organizations of the United States," Miscellaneous Series No. 99, has just been issued by the Bureau of Foreign and Domestic Commerce in bulletin form. This is the first edition of this directory to be published since 1917. Copies can be obtained for 15 cents by applying to any of the co-operative offices of the bureau.

Supply Jobbers' Notes

THE CARTER ELECTRIC COMPANY, Atlanta, Ga., has issued invitations to all its dealers throughout Georgia and adjacent territory to attend the "get-together Carter Electric Company meeting," to be held in Atlanta on April 6 and 7. Several prominent out-of-town representatives of manufacturers are scheduled to attend this meeting.

THE REPUBLIC ELECTRIC COMPANY, 120 East Front Street, Davenport, Iowa, recently organized, has purchased a building, 32 ft. x 145 ft., four stories high, and expects to take possession May 1. The company expects to act as wholesale distributers of electrical apparatus and equipment. Its operations for the present will be devoted principally to territory within a 100-mile radius of Davenport. A comprehensive general supply catalog will be published as soon as its various lines and factory connections have been established. Thomas H. Harris, general manager of the company, has been connected with the electrical industry since 1893, and his experience covers a wide range, including electric light, telephone and street railway construction work and central-station management. More recently he was district manager for both the Post-Glover Electric Company of Cincinnati, Ohio, and the Varney Electrical Company of Indianapolis, Ind.

Foreign Trade Notes

SERBIA PURCHASES GOVERNMENT CABLE.—The director of sale of the surplus property division of the War Department announces that on bids opened on Feb. 24 the Kingdom of Serbs, Croats and Slovenes has purchased approximately 27,250,000 ft. of twisted-pair copper wire in sizes from No. 10 to No. 17 and approximately 1,500,000 ft. of ten and fifteen-pair wire cable, most of which is telephone.

JAPAN NEEDS EQUIPMENT.—Notwithstanding the rapid development of electrical industry in Japan, it is expected that there will be a continued demand for imported high-tension switching apparatus.

AMERICA'S PROPORTION OF CHINESE IMPORTS LOW.—According to the report of the American Chamber of Commerce in China, the United States is exporting to China only 20 per cent of the electrical materials and fittings which that country is importing.

JAPANESE ELECTRICAL EXPORTS AND IMPORTS.—The total value of electrical apparatus manufactured in Japan in 1918 was, according to a Japanese contemporary, $72,000,000. Exports amounted to $10,000,000 and imports to $6,900,000. Apparatus valued at $6,500,000 was exported in the first nine months of 1919.

FOREIGN TRADE CONVENTION.—The seventh national trade convention, called by the National Foreign Trade Council, will be held at San Francisco, Cal., on May 12, 13, 14 and 15. The convention theme is "The Effect of Being a Creditor Nation." The office of the National Foreign Trade Council is at India House, No. 1 Hanover Square, New York City. O. K. Davis is secretary.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An American mechanical and electrical engineer in Cuba (No. 32,345) who is manager of a machinery jobbing house desires to secure agencies for the sale of steam and electrical machinery and equipment.

A firm in Danzig (No. 32,309) is interested in handling an agency on a commission basis for the sale of railway sleepers and telegraph poles. It would like to get into direct communication with leading sawmills.

A sales agency firm in India (No. 32,363) desires to secure the sole representation of manufacturers for the sale throughout India of electrical accessories, electric lamps and telephones.

Trade Publications

SPRAY-COOLING EQUIPMENT. — The Star Brass Works, manufacturing engineers, 3114-28 Carroll Avenue, Chicago, now have ready for distribution their new twenty-four-page bulletin, No. 4-A, covering spray-cooling equipment for the cooling of water from steam and ammonia condensers.

GALVANOMETERS. — "The Galvanometer," by E. F. Northoup is the subject of bulletin No. 11, recently issued by the Pyroelectric Instrument Company, 636-640 East State Street, Trenton, N. J.

SUPERHEATERS FOR STATIONARY POWER PLANTS.—The Locomotive Superheater Company, 30 Church Street, New York, has issued bulletin T-5, covering the use of superheat steam in operating engines and steam turbines. It contains "steam consumption" curves and "superheat" curves for various types of steam prime movers.

TUBES, RODS AND WIRES.—Prices, sizes, etc., of copper and brass tubes, copper, brass and bronze rods and wires are given in bulletin No. 100-1, recently issued by the Standard Underground Cable Company, Pittsburgh, Pa.

ELECTRIC WELDING MACHINERY.—The Federal Machine & Welder Company, Warren, Ohio, has issued several bulletins describing different types of its welding machinery as follows: Bulletin No. 31 covers Federal electric butt welders, Bulletin No. 32 Federal junior type spot welder, Bulletin 33 Federal "Universal" spot welders, Bulletin 34 Federal butt welders, and Bulletin 35 Federal No. 22-A electric tube welder and roller.

GRAPHIC INSTRUMENTS.—The "Esterline Graphic," published by the Esterline Company, Indianapolis, Ind., describes the use of Esterline graphic instruments in the field of transportation.

MOTORS.—The Valley Electric Company, St. Louis, Mo., has issued an illustrated booklet describing its motors. It also gives an account of manufacturing motors from the raw material to the finished machine.

MODERNIZING INDUSTRIES. — The Standard Electric & Elevator Company, Baltimore, Md., has issued an eighty-page booklet entitled "Modernizing America's Industries," suggesting methods for industrial modernization and giving facts that might be of value to officials, managers, production engineers and maintenance engineers interested in America's industries.

New Incorporations

THE JENKS (OKLA.) UTILITIES CORPORATION has been incorporated with a capital stock of $100,000 by A. J. Elliott of Jenks and Fred W. Kopplin of Tulsa.

THE KEYSER (W. VA.) ELECTRIC COMPANY has been incorporated with a capital stock of $125,000 by Louis Gerber, Robert S. Sigley and E. L. Wilson, all of Trenton, N. J.

THE MARTIC-DRUMORE ELECTRIC LIGHT, HEAT & POWER COMPANY of Holtwood, Pa., has been incorporated with a capital stock of $15,000 by Robert H. Long of Drumore, R. D. 1.

THE LITCHFIELD COUNTY MANUFACTURING COMPANY of Winsted, Conn., has been incorporated with a capital stock of $25,000 to manufacture electrical fixtures and brass goods. The company has leased the Goodwin and Kintz plant on Rowley Street. David Goldrich is interested in the company.

THE BOLIVIAN POWER & LIGHT COMPANY of Wilmington, Del., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $2,000,000 to operate light and power plants, etc. M. L. Roberts, L. A. Irwin and W. G. Singer of Wilmington are local incorporators.

THE MASSEY (MD.) ELECTRIC LIGHT & POWER COMPANY has been organized to install an electric light plant in Massey. L. C. Clark is manager.

THE JACKSON (MICH.) PUBLIC SERVICE COMPANY has been chartered with a capital stock of $600,000 by Joseph H. Brewer, Charles McPherson and Blaine Gavett, all of Grand Rapids, Mich. The company, it is understood, is a reorganization of the Jackson Light & Traction Company.

THE MASTER WELDING COMPANY of Los Angeles, Cal., has been incorporated with a capital stock of $55,000 to manufacture welding equipment. The incorporators are G. E. Torbet and R. A. Jatho, 324 East Fortieth Street, Los Angeles.

THE MODERN ELECTRIC COMPANY of Torrington, Conn., has been incorporated by Luke Carlin, E. B. Van Norden and G. L. Vannais. The company is capitalized at $25,000 and proposes to manufacture electrical products.

THE COMMONWEALTH BATTERY CORPORATION, 17 Elm Street, Rochester, N. Y., has been incorporated with a capital stock of $50,000 to manufacture plates for storage batteries. Linus Herberger is secretary.

THE BURR APPLIANCE COMPANY of Holyoke, Mass., has been incorporated with a capital stock of $250,000 to manufacture and deal in electrical and mechanical equipment. The incorporators are Charles F. Munder of Springfield, Charles D. Haywood and Russell L. Davenport of Holyoke, Mass.

THE KATH ELECTRIC COMPANY of Milwaukee, Wis., has been incorporated with a capital stock of $10,000 by John P. Kinkert and F. W. Kath of Milwaukee.

THE UNION & ELECTRIC MANUFACTURING COMPANY of Cuyahoga Falls, Ohio, has been incorporated with a capital stock of $10,000 by A. E. Sharkey and H. S. Knoch.

THE C. & D. ELECTRIC COMPANY of Stoughton, Mass., has been incorporated by Harry L. Crozier of Brockton, John R. Dykeman and Arthur H. Dykeman, both of Stoughton. The company is capitalized at $25,000 and proposes to manufacture and deal in electrical appliances.

New England States

AUGUSTA, ME.—The Millinocket Light Company has been authorized by the Public Utilities Commission to issue $74,000 in bonds, of which $25,000 will be used for improvements.

CLARK MILLS, ME.—The Clark Power Company contemplates erecting a power house. Sawyer & Bean, 11 Lisbon Street, Lewiston, are engineers.

ASHLAND, MASS.—Dr. Sweet's Root Beer, Inc., 10 Post Office Square, Boston, contemplates building a three-story plant and power house in Ashland.

BONDSVILLE, MASS.—The Boston Duck Company has purchased a site on Swift River for a proposed power plant.

HOLYOKE, MASS.—A transmission line will be built from the municipal electric plant to Willimansett, at a cost of about $15,000.

LANCASTER, MASS.—An extension of the municipal electric lighting system from the town farm to the Lancaster-Leominster line has been authorized.

MIDDLETON, MASS.—The sum of $2,000 has been appropriated for proposed improvements in the municipal lighting system.

SALEM, MASS.—The Salem Electric Company will soon be in the market for a turbine and boilers.

NEW LONDON, CONN—An ornamental lighting system for the business section of Main Street is being considered.

Middle Atlantic States

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company has petitioned the Public Service Commission for permission to increase its capital stock from $1,022,000 to $1,622,000 for expansion and improvements.

CHURCHVILLE, N. Y.—Application has been filed with the Public Service Commission for authority to construct a municipal electric system.

HERKIMER, N. Y.—An addition to the municipal electric plant and the installation of a new equipment at a cost of $160,000 is being considered by the Municipal Commission. Michael Foley is president.

MEDINA N. Y.—Plans are under consideration by the Town Council for improvements to the electric lighting system.

ROCHESTER, N. Y.—The Alderman & Fairchilds Company of Churchville is considering plans for the erection of a power plant for its paper-box factory.

ROCHESTER, N. Y.—The Rochester Gas & Electric Company has petitioned the Public Service Commission for permission to issue $500,000 of stock for contemplated plant improvements.

SARDINIA, N. Y.—The Holland-Sardinia Light & Power Corporation has applied to the Public Service Commission for permission to operate.

BURLINGTON, N. J.—The United States Cast Iron Pipe & Foundry Company contemplates additions to the power plant at its local works to include one 350-kw., 250-volt, direct-current turbo-generator and a 100-kw. motor-generator set, alternating current, 2,200 volts, two-phase, 60-cycles; direct current, 250 volts. Alexander A. Gettlin is electrical engineer.

BUTLER, N. J.—The Town Council has called for plans for the proposed extension to the municipal lighting plant, to cost about $50,000.

IRVINGTON, N. J.—The Vreeland Motor Company, 407 Elizabeth Avenue, Newark, is receiving bids for construction of a factory on Cort Street, to cost about $300,000. Electrical and mechanical equipment will be required. J. T. Simpson, Essex Building, Newark, is architect.

TRENTON, N. J.—The Western Union Telegraph Company has made application to the City Commission for permission to place its system underground on West Hanover Street.

CHESTER, PA.—The Sun Shipbuilding Company plans additions to its plant on the Delaware River in connection with which large quantities of electrical and mechanical equipment will be required. The total cost will be about $3,000,000.

CONNELLSVILLE, PA.—The Paragon Motor Company, 404 Century Building, Cleveland, Ohio, plans to erect two factory buildings, to cost about $500,000, and install electric motors and a crane. F. F. Hockenthal is the company engineer. J. F. Kurtz is president.

PHILADELPHIA, PA.—The Philadelphia Electric Company has completed plans for a substation at Marshall and Noble Streets.

PHILADELPHIA, PA.—Bids are now being received by the Bureau of Water, 788 City Hall, for delivery and installation of one electric traveling crane, three 220-volt, direct-current motors, controllers, limit switch, wiring and switchboard at the Lardner's Point pumping station.

POTTSVILLE, PA.—Preparations are being made by the Eastern Pennsylvania Light, Heat & Power Company for extensive improvements and extensions to its system during 1920, some of which are already under way. The company has recently closed a contract with the Metropolitan Edison Company of Reading for a tie-in with its lines at a point south of Port Clinton, which will necessitate the erection of a three-phase, 60-cycle, 23,000-volt transmisson line, about 16 miles long. The line conductors will be No. 1 solid copper and 45,000-volt insulators will be used so that at a later date the line can be changed to 38,000 volts. This line is under construction. The installation of four additional Coxe traveling grates under four 350-hp. Stirling boilers is contemplated. A 500-gal. Terry turbine-driven centrifugal feed-water pump, a 10-kw. direct-current Terry turbine-driven auxiliary unit for operating oil switches and relays, which unit will also be the source of supply for emergency lighting in the generating station at Palo Alto, and a 100-kw. motor-driven exciter set are now being installed at the latter plant. Three additional 567-kva. transformers will be placed in the Tamaqua substation and two switchboards will be completely rearranged and overhauled. An additional 1,250-kva. synchronous condenser has been purchased and will be installed in the Frackville substations within the next ninety days. W. G. Long is manager of the commercial department.

SCRANTON, PA.—The Scranton Electric Company contemplates the erection of a new machine shop to cost about $30,000.

VARDEN, PA.—Improvements are contemplated by the Varden & Lake Ariel Light, Heat & Power Company, including changing its system from direct to alternating current. New equipment may be needed, including a waterwheel, switchboard, generator, transformers and overhead-line material for about 4 miles of transmission lines. W. W. Kizer is president.

BALTIMORE, MD.—The M. A. Long Company, engineer and constructor, Munsey Building, has been awarded a building contract for the new plant to be erected in this city by the Columbia Graphophone Company of Bridgeport, Conn. A large power plant is included in the project. The total cost is estimated at $2,500,000.

BEECH BOTTOM, W. VA.—The American Gas & Electric Company, New York, N. Y., contemplates additions to its local plant.

FAIRMONT, W. VA.—The Monongahela Valley Traction Company contemplates installing a turbo unit with auxiliaries, to cost $700,000, at the local plant, and also new equipment at its Parkersburg plant.

RICHMOND, VA.—Considerable electrical equipment will be required in connection with the construction of the new club house of the Westmorehead Club, Grace Street. Cost is estimated at $350,000. A. C. Bossom, 680 Fifth Avenue, New York, N. Y., is architect. G. Bryan is president of the club.

North Central States

CHICAGO, ILL.—Plans are being prepared by Graham Anderson Probst & White, architects, Railway Exchange Building, for a fourteen-story Federal Reserve Bank and office building to cost about $3,000,000. Considerable electrical equipment will be necessary.

BATTLE CREEK, MICH.—The Clark Equipment Company, manufacturer of motor axles, plans a $5,000,000 factory. Considerable electrical equipment will be required.

DETROIT, MICH.—Motors and other electrical equipment will be required for the new factory of the Blodgett Engineering & Tool Company, Kerr Building. A. E. Harley, 435 Woodward Avenue, is architect.

FLINT, MICH.—Plans are being revised by Malcolmson, Higginbotham & Palmer, architects, 405 Moffat Building, Detroit, for a high school to cost about $1,250,000. Power motors and other electrical equipment will be required.

CLEVELAND, OHIO.—A new street-lighting system is under consideration for Nela Park and Euclid Avenue in East Cleveland.

CLEVELAND, OHIO—Charles Shane, 2147 Ontario Street, will erect a private electric plant in connection with the construction of new twelve-story store and office building to cost $750,000. W. S. Lougee, Marshall Building, is architect.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until April 8 for material and parts for flashlight re-call and signal system for the division of police, department of public safety.

CLEVELAND, OHIO. — The Templar Realty Company, 1605 Williamson Building, is having plans prepared by S. H. Weis, architect, 1032 Schofield Building, for an eight-story commercial building, to cost about $500,000. Electric wiring and elevator equipment will be installed.

CLEVELAND, OHIO. — Considerable electrical equipment will be required by the National Acme Company, manufacturer of machinery, 7500 Stanton Avenue, for its proposed $500,000 factory additions. G. S. Rider & Company, Century Building, are architects.

CLEVELAND, OHIO.—Plans are being prepared by W. R. McCormack, architect, East Sixth Street and Rockwell Avenue, for a three-story junior high school to cost about $600,000. Electric motors, stoves and wiring will be installed.

LEBANON, OHIO.—Bids will be received until April 27 by the Board of Trustees of Public Affairs for construction of a complete new municipal electric light plant, to cost about $135,000. Oliver Chenoweth is president of the board.

LISBON, OHIO.—Ohio Gas & Electric Company contemplates the erection of transmission lines to various rural districts.

LONDON, OHIO.—The Ohio Board of Administration, Columbus, contemplates the construction of a $100,000 power house for the new state prison in London.

SALEM, OHIO.—The Salem Lighting Company contemplates spending $175,000 for additional equipment.

TOLEDO, OHIO—The substation of the Toledo Railways & Light Company at the Casino was recently destroyed by fire, the loss amounting to $50,000. The company plans to rebuild immediately on a new site. F. J. Derge is assistant manager.

UHRICHSVILLE, OHIO.—Proposals for building a municipal light plant will be submitted to the voters.

WARREN, OHIO—The Alloy Electrical Steel Casting Company of Massillon contemplates the erection of a new factory building on site offered by the Warren Board of Trade. Electrical furnaces and other equipment will be installed.

JEFF, KY.—The Kermont Coal Company will electrify its mines.

PRAISE, KY.—The Kanawha Elkhorn Collieries, 217 Ellicott Square, Buffalo, N. Y., contemplate installing three 150-kw. direct-current engine-type generators directly connected. R. C. Simpson is general superintendent.

KOKOMO, IND.—The International Engineering & Manufacturing Company, 327 South La Salle Street, Chicago, Ill., plans to establish a plant to cost about $100,000 in Kokomo for the manufacture of electric lighting power plants for farm purposes.

ROACHDALE, IND. — The Roachdale Electric Light Company has purchased the plant of the Ladoga Electric Light Comapny and will connect the two towns with a transmission line.

JACKSONVILLE, ILL.—The City Council has approved plans for construction of a new municipal power house and filtration plant, to cost about $40,000. The city clerk has been authorized to call for bids for same. H. L. Caldwell, engineer.

MATHERVILLE, ILL.—The Sherrard Power & Light Company has petitioned the Illinois Public Utilities Commission for permission to construct plant in Matherville.

PEORIA, ILL.—The Staley Manufacturing Company of Decatur will erect a plant to cost $500,000 as the first unit of a contemplated project to exceed $5,000,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

CUDAHY, WIS.—The Federal Rubber Company is planning improvements to its local plant, including the installation of a 4,000-kw. substation (receiving station), air compressors with motors, high-pressure hydraulic pumps and additional motors, aggregating 2,000-hp., for industrial purposes. H. F. Godeke is engineer of steam station.

MISHICOT, WIS.—Plans are under consideration to connect the local electric light plant with the transmission system of the Wisconsin Public Service Company. J. Beyer is president of the local company.

SHEBOYGAN, WIS.—The Cigar Box Lumber & Manufacturing Company is having plans prepared by Juhl & Smith, architects and engineers, Innig Building, for a machine, saw, filing and power house, to cost about $50,000. Electric generators will be installed to furnish all power required. J. Will, 1007 Michigan Avenue, is president.

CHISHOLM, MINN. — The Minnesota Utilities Company of Eveleth plans to enlarge its local generating plant, to cost $150,000.

HUTCHINSON, MINN.—Bonds to the amount of $15,000 have been voted for an ornamental street-lighting system.

ST. PAUL, MINN.—Considerable electrical equipment will be required in connection with the six-story hotel to be erected at a cost of $500,000 by A. H. Heimbach, 467 Roy Street. M. A. Wright, 600 Pittsburgh Building, is architect.

TRUESDALE, IOWA. — Bonds to the amount of $4,000 have been sold for contemplated improvements in the municipal electric lighting system.

ASHLEY, N. D.—Bids will be received by J. Hildenbrand, auditor of McIntosh County, until April 6, for wiring of new court house. Plans may also be obtained from Buechner & Ortht, architects, 500 Shubert Building, St. Paul, Minn.

CANDO, N. D.—The reconstruction of the entire municipal transmission system is being contemplated. F. L. Anders is in charge of the work.

COOPERSTOWN, N. D.—The People's Service Company is having plans prepared for a power plant and additional transmission lines. The cost will be about $275,000. C. Christianson is manager.

RED CLOUD, NEB.—The Municipal Light and Water Department contemplates additions to its distribution system. J. A. Brodferd is superintendent.

OTTAWA, KAN.—The Baptist University contemplates the erection of a power house to cost about $75,000. Washburn & Stoockey, Ottawa, are architects and engineers.

TOPEKA, KAN.—The Pawnee Power & Water Company will issue $37,250 of stock for improvements to its lighting system.

Southern States

HIGH POINT, N. C.—The High Point Hotel Company will erect a hotel at a cost of about $500,000 requiring considerable electrical equipment. W. L. Stoddart, 9 East Fortieth Street, New York, N. Y., is engineer and architect.

KINGSTON, N. C.—The erection of a new municipal electric plant, to cost not more than $300,000, is contemplated. W. C. Olsen, Sumter, S. C., is consulting engineer. J. E. Weyher is superintendent.

RALEIGH, N. C.—The R. G. Lassiter Company is in the market for a 10-hp. to 60-hp. boiler, motors, transformers and trucks, all second-hand.

CHARLESTON, S. C.—Bids will be received until April 15 at the office of the supervising architect, Treasury Department, Washington, D. C., for the installation of a lighting plant and water system at the United States Quarantine Station at Charleston.

AUGUSTA, GA.—The Sibley Manufacturing Company, Goodrich Street, contemplates the erection of a cotton mill, including a water-power plant and dye house. Complete equipment for electrical operation will be installed. J. E. Sirrine, Greenville, S. C., is engineer.

LA GRANGE, GA.—Preparations are being made by the Valley Waste Mills for installing an additional receiving station of about 750 kw. capacity and also a number of new motors. W. H. Jones is manager.

PABLO BEACH, FLA.—The Town Clerk is receiving bids for equipment of power plant, including a 100-125-hp. oil engine, switchboard and generator.

ALCOA, TENN. — The Aluminum Company of America, Oliver Building, Pittsburgh, Pa., contemplates the construction of four additional hydro-electric power dams near Alcoa in connection with the local plant now being erected. A. V. Davis is president.

BIRMINGHAM, ALA.—Plans are being prepared by the Sloss-Sheffield Steel & Iron Company for equipping for electrical operation machinery in coal and iron mines, blast furnaces and a by-products plant in connection with its new works now under construction. The maximum motor load will be about 5,000 hp. to start with. Part of the project will be in operation about June, 1920, and will be completed in June, 1921. Electricity will be furnished by the Alabama Power Company. Martin J. Lide of Birmingham is consulting engineer.

LITTLE ROCK, ARK.—The Arkansas Light & Power Company contemplates the erection of a transmission line to Russellville.

PICRON, ARK.—The Arkansas Light & Power Company of Arkadelphia has purchased the municipal power plant and 40 acres of land for $235,000. Extensive improvements are planned, to include erection of additional transmission lines and a substation in North Little Rock. H. C. Couch is president.

MONROE, LA.—The municipal power and water plant, recently destroyed by fire, is to be rebuilt. A Berstein is Mayor.

TULIA, TEX.—A municipal electric light and water plant is under consideration.

WICHITA FALLS, TEX.—The Chamber of Commerce has approved plans for the proposed ornamental street lighting system.

Pacific and Mountain States

SEATTLE, WASH.—The Medical Building Company, Cobb Building, is having plans prepared by Bebb & Gould, architects, at the same address, for an eight-story office building to cost $450,000 and requiring considerable electrical equipment.

SULTAN, WASH.—An additional generating unit will be installed in the municipal power plant. F. I. Anderson is superintendent.

FLORENCE, ORE.—The Florence Electric Company has filed application with the Public Service Commission for permission to increase its rates for reconstruction purposes. The plant was recently destroyed by fire.

FOREST GROVE, ORE.—Bids will be received in April by the Masonic Lodge for construction of a two-story Masonic home, to cost about $230,000. A separate power house will be erected. W. C. Knighton, United States National Bank Building, Portland, is architect.

BISHOP, CAL.—The Southern Sierras Power Company, which recently purchased the property of the Mono Power Company, on Owens River, contemplates extensive improvements, involving an expenditure of over $2,000,000. Work on the first unit is under way. C. H. Rhudy, engineer, is in charge. The plans include a 27,000-hp. hydro-electric development.

HERMOSA BEACH, CAL.—At an election on April 12 the proposal to issue $5,000 in bonds for a street-lighting system will be submitted to the voters.

LONG BEACH, CAL.—The Seaside Investment Company, care of A. B. Benton, 114 North Spring Street, architect, contemplates the installation of a boiler plant and electrical equipment in connection with the construction of the proposed new bath house and hotel.

LOS ANGELES, CAL.—The Los Angeles Railway Company is having plans prepared by C. E. Noerenberg, architect, for a ten-story office building, for which motors and other electrical equipment will be required.

MARE ISLAND, CAL.—The Bureau of Yards & Docks, Navy Department, Washington, D. C., contemplates the installation of a 4,000-kw. turbo-generator at the local navy yard.

SACRAMENTO, CAL.—The State Reclamation Board has approved plans of District 2021 for completing its work of reclamation in the Mildred Island district of San Joaquin County. The contemplated improvements, including new pumping facilities, will cost upward of $300,000.

SAN FRANCISCO, CAL.—H. H. Wadsworth has applied to the State Water Commission for permission to take 200 cu. ft. per second from the middle fork of the Yuba River, Sierra and Nevada Counties, for power purposes, and 700 cu.ft. per second from Yuba River, Yuba County, also for development of power. Project will cost about $2,500,000.

SAN FRANCISCO, CAL.—Application has been filed with the State Water Commission by L. S. Jorgensen, Chronicle Building, for permission to divert 350 cu.ft. per second of water from the middle fork of the Feather River, in Plumas and Butte Counties, for hydroelectric development. Project will cost about $6,000,000. Mr. Jorgensen has also applied to take 450 cu.ft. per second of water from another point in the same river, and the diversion works in this latter development will cost in the neighborhood of $4,500,000.

WILMINGTON, CAL.—The California Barium & Chemical Company, J. O. Sword, Higgins Building, Los Angeles, recently organized with a capital stock of $250,000, plans to erect a group of factory buildings equipped with electric motors, etc. A. C. Martin, 430 Higgins Building, Los Angeles, is architect.

HEYBURN, IDAHO. — Bonds to the amount of $5,000 have been issued for the erection of a municipal power plant.

RUPERT, IDAHO.—The city will operate the Rupert Electric Company's system, which it has just purchased for $37,500. J. C. Lundy is manager.

WASATCH, UTAH.—The Whitmere Oxygen Company of Salt Lake has applied to the state engineer for permission to take 30 cu.ft. per second of water from Little Cottonwood Creek, Salt Lake County, for power.

BILLINGS, MONT.—Bids will be received in April by McIver & Cohagan, architects, 407 Electric Building, for a six-story hotel, to cost about $700,000. Considerable electrical equipment will be required. A. H. Barth, 43 Yellowstone Avenue, is the owner.

LAUREL, MONT.—The City Council is considering improvements in the electric lighting system, estimated to cost $5,500.

SHERIDAN, WYO.—Bids will be received by E. C. Gwillim, city engineer, for furnishing and installing sixty-six ornamental street-lighting posts.

WORLAND, WYO.—The Big Horn Light & Power Company contemplates the installation of two 150-kva., three-phase, 60-cycle, 2,300-volt engine-driven generators, with switchboard equipment and transformers. M. W. Thompson is engineer.

Canada

DES QUINZE, ONT.—An extensive power development is contemplated in connection with a proposed pulp and paper plant, to cost about $4,000,000. M. J. O'Brien of Renfrew is said to be interested.

FENWICK, ONT. — The Pelham Township Council is considering the construction of a municipal hydro-electric system.

HAMILTON, ONT.—J. & J. J. Allen, Richmond and Victoria Streets, have purchased a site on King and William Streets on which they plan to erect a motion-picture theatre to cost about $500,000. Electrical equipment will be required for lighting, heating and ventilating and motion picture machines.

LONDON, ONT.—The construction of a municipal water main and pumping plant, equipped with electric pumps to supply the Canadian Pacific Railway is under consideration. The cost is estimated at $20,000. E. V. Buchanan, Hydro offices, is engineer and manager of waterworks.

TORONTO, ONT.—The Henry Engineering Company, 71 Bay Street, is in the market for a 1,000-kva., three-phase, 25-cycle, 2,200-volt turbine or engine generating unit and a 500-hp. water-tube boiler.

MONTREAL, QUE.—The Shipman Electric Engineering Company, 26 George Street contemplates the purchase of three 75-kva., 550 to 2,200-volt, 60-cycle transformers, and motors ranging up to 100-hp. at 550 volts, three-phase, 60-cycle.

SHERBROOKE, QUE.—The Corporation of the Sherbrooke Gas & Electric Department, which has taken over the property of the municipal electric light plant, contemplates the construction of a 11,000-hp. plant at Westbury and the erection of 2 miles of 50,000-volt line. C. Desbraillet is manager.

Miscellaneous

GUAM, P. I.—The Bureau of Yards & Docks, Navy Department, Washington, D. C., plans to erect power house, pump house, blower house and quarters at the naval radio station in Guam (Specification 4141). Plans may be obtained on deposit of $20 at the above office.

CARBONEAR, NEWFOUNDLAND — The United Towns Electric Company, plans a general expansion in its generating and transmission systems. J. C. Cameron is secretary.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, Nepecnauk Bldg., 63 East Adams St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual convention, White Sulphur Springs, W. Va., June 29-July 2.

AMERICAN PHYSICAL SOCIETY. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

ARKANSAS UTILITIES ASSOCIATION. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Hot Springs, Ark., April 26-28.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES OF ONTARIO. Secretary, S. R. A. Clement, 190 University Ave., Toronto.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill. Annual meeting, Chicago, Ill., Oct. 28-31.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C. Annual meeting, Vancouver, B. C., Oct. 19.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, F. O. Safford, Denver Gas & Electric Co., Denver, Col. Annual convention, Glenwood Springs, Col., September.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 19 West 44th St., New York City. Annual meeting, White Sulphur Springs, W. Va.

COMMERCIAL SECTION, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRIC HOIST MANUFACTURERS' ASSOCIATION. Secretary-treasurer, W. C. Briggs, Shepard Electric Crane & Hoist Co., New York City.

ELECTRIC FURNACE ASSOCIATION. Secretary, Dr. C. G. Schluederberg, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, F. L. Bishop, Hartford Faience Co., Hartford, Conn.

ELECTRICAL SAFETY COUNCIL. Secretary, Dana Pierce, 25 City Hall Place, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill., Annual meeting, Del Monte, Cal., May 12-14.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADE ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada.

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

ELECTRIC VEHICLE SECTION, N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria Street, Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), Arthur J. Binz, Houston, Tex.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Ann Arbor, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary and treasurer, Meyer Barnert, St. Paul, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION, affiliated with the N. E. L. A. Secretary, E. S. Myers, Vicksburg, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 315 N. 12th St., St. Louis, Mo. Annual convention, Jefferson City, Mo., June 3-5.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin. Annual convention, Baltimore, Md., Oct. 6.

NATIONAL COUNCIL OF LIGHTING FIXTURE MANUFACTURERS. Secretary, C. W. Hoffrichter, 8410 Lake Ave., Cleveland, Ohio.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive assistant to president, M. H. Aylesworth, 29 West 39th St., New York City. Annual convention, Pasadena, Cal., May 18-21.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass. Annual convention, Kineo, Me., Sept. 14-16.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION, affiliated with N. E. L. A. Secretary, W. E. Herring, 860 Stuart Bldg., Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 13-16.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, Rialto Bldg., San Francisco, Cal. Annual meeting, Hotel Del Monte, Del Monte, Cal., May 17, 18.

PENNSYLVANIA ELECTRIC ASSOCIATION, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, L. V. Schneider, Salem, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex. Annual convention, Galveston, Tex., May 13, 14 and 15.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

TECHNICAL AND HYDROELECTRIC SECTION, N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual convention, Atlanta, Ga., May 19-21.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vermont.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis.

(Issued March 16, 1920.)

1,333,596. Telephone System; Wallace P. Andrick, Jamaica, N. Y. App. filed Sept. 25, 1917. Bridge holds trunk circuit, a substitute for answering set.

1,333,607. Trolley System; Ora A. Colby, Larimer, Pa. App. filed Feb. 3, 1915. Sliding-contact pantograph for catenary line construction.

1,333,608. Method and Apparatus for Electric Lighting and Starting Vapor Conductors; John W. Dorsey, Winnipeg, Manitoba, Canada. App. filed June 16, 1917. Constant-pressure vapor electric apparatus.

1,333,626. Control Apparatus; Ferdinand G. Moard, Turtle Creek, Pa. App. filed July 3, 1916. Magnetically actuated valves for controlling fluid under pressure.

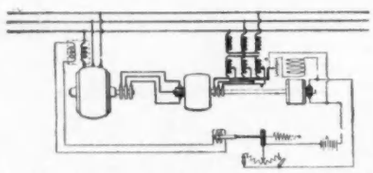
1,333,633. Apparatus for Sterilizing Liquids; Harry B. Rudd, Akron, Ohio. App. filed Sept. 22, 1919. Valve opens when liquid is heated to desired temperature.

1,333,640. Electric Insulator; Guido Semenza, Milan, Italy. App. filed Jan. 23, 1918. Prevents stresses due to expansion or contraction.

1,333,662. Electric Regulator; August Kazenmaier, Stuttgart, Germany. App. filed July 15, 1918. For keeping voltage or current constant.

1,333,664. Speed Control for Induction Motors; Benjamin G. Lamme and Wilfred Sykes, Pittsburgh, Pa. App. filed Oct. 21, 1916. Free from surging and allied harmful phenomena.

1,333,665. Arc Lamp; George M. Little, Pittsburgh, Pa. App. filed Nov. 12, 1915. Prevents fumes from attacking glass or metal parts.



No. 1,333,664. Speed Control for Induction Motors

1,333,698. Spark-Plug Tester; Ernest I. Bass, Cornersville, Tenn. App. filed March 3, 1919. Spark-intensity detector.

1,333,700. Process and Apparatus for Electrical Treatment in the Dyeing of Fibers and Fiber Products and the Dyestuffs and the Product Resulting Therefrom; Jacob E. Bloom, Brooklyn, N. Y. App. filed Dec. 3, 1917. By electrical transference and adsorption.

1,333,701. Manufacture of Loose Compounds; Jacob E. Bloom, Brooklyn, N. Y. App. filed Dec. 3, 1917. Electrically compacting colloids.

1,333,720. Copper-Lead-Smelting Process; Woolsey McA. Johnson, Hartford, Conn. App. filed Oct. 24, 1914. Utilizing thermal energy of fuel and of electricity.

1,333,724. Heating Device by Electricity; Pierre P. Meunier, Lyon, France. App. filed June 6, 1919. Insulating plate acts as screen.

1,333,744. Telephone Transmitter; Edward C. Wente, New Haven, Conn. App. filed Dec. 20, 1916. For sound-wave analysis.

1,333,758. Telephone System; Charles W. Keckler, Newark, N. J. App. filed May 24, 1917. Obtains clear circuit to central office free from interruptions.

1,333,771. Voltaic Cell and Battery; Frederick R. Parker, Chicago, Ill. App. filed Jan. 29, 1910. Connects two or more cells together.

1,333,789. Spark Gap Used in Wireless Telegraphy; Joseph F. J. Bethenoid and Emile F. Girardeau, Paris, France. App. filed Oct. 15, 1915. Synchronic operation of spark gaps in parallel.

1,333,805. Receiver Attachment for Telephones; Samuel H. Hamer, Bellingham, Wash. App. filed Nov. 5, 1918. Supports receiver in proper position from stand.

1,333,836. Art of Producing Charges for Power Devices; Henry Csanyi, New York, N. Y. App. filed Feb. 28, 1918. Decomposing treatment augments oxygen of atmosphere.

1,333,837. Art of Producing Charges for Power Devices; Henry Csanyi, New York, N. Y. App. filed March 2, 1918. Heavier hydrocarbons foundation for content of charge.

Record of Electrical Patents

Notes on United States Patents

1,333,838. Art of Producing Charges for Power Devices; Henry Csanyi, New York, N. Y. App. filed May 13, 1918. Electrolytic cell has spaced plates as electrodes.

1,333,849. Solution of Titanium and Iron Salts and the Process of Preparing Same; Hjalmar Olsen, Christiania, Norway. App. filed May 16, 1917. Pure titanium hydrates precipitated while iron remains in solution.

1,333,892. Parallel-Feeder Protection; Paul Ackerman, Toronto, Ontario, Canada. App. filed Dec. 24, 1917. Isolates faulty feeder from system.

1,333,904. Rail Bond; Edward M. Deems, Forest Hills, N. Y. App. filed Jan. 8, 1919. For signal purposes.

1,333,914. Electric Furnace and Method of Operation; Louis C. H. Groeger, Chicago, Ill. App. filed April 5, 1919. Operated single-phase, two-phase or three-phase.

1,333,933. Electrically Operated Air-Heating Device; Andrew P. Nickols, Bridgeport, Conn. App. filed Oct. 18, 1919. Attached to conduit for raising temperature of air or gas.

1,333,936. Current-Regulating Plug and Socket; Antonio Papini, Philadelphia, Pa. App. filed Dec. 1 1919. Rheostats containing graphite mixed with pulverized mica.

1,333,950. Electric Furnace; Max R. Trembour, Watervliet, N. Y. App. filed March 24, 1916. Of spherical design for minimum power consumption.

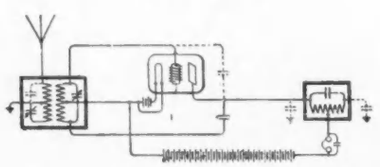
1,334,004. Process for the Treating of Titaniferous Iron Ore; Jacobus van der Toorn, The Hague, Netherlands. App. filed March 25, 1918. Briquettes of titanic iron ore, the carbon and flux subjected to electric flame arc.

1,334,035. Electric Heater for Stock-Watering Tanks; Wilson E. Johnson, Kempton, Ind. App. filed Aug. 16, 1919. Water-tight heater in bottom of trough contains resistances.

1,334,040. Electric Connection; Thomas L. Lee, Rochester, N. Y. App. filed June 12, 1918. Flexible cable attached to socket terminal by plug on end of conductor.

1,334,041. Insulating and Cooling Means for Transformers; Arvid Lindstrom, Wasteras, Sweden. App. filed March 6, 1919. Compressed gas as insulating medium.

1,334,047. Signal for Vehicles; Timothy B. Powers, Brooklyn, N. Y. App. filed Aug. 11, 1919. Illuminated hand signal mounted on rear fenders.



No. 1,334,118. System of Amplification of Small Currents

1,334,077. Semi-Mechanical Telephone System; Albert M. Bullard, New York, N. Y. App. filed Feb. 5, 1907. Special signal for revertive calls.

1,334,080. Impulse-Sending Device; Henry P. Clausen, Mount Vernon, New York, N. Y. App. filed Feb. 23, 1918. For controlling automatic telephone switches.

1,334,084. Electric Connection; Farnum F. Dorsey, Rochester, N. Y. App. filed June 12, 1918. Sheet-metal plug.

1,334,087. System for Producing Oscillations; Alfred N. Goldsmith and Julius Weinberger, New York, N. Y. App. filed March 23, 1918. Constants of oscillating system independent of antenna constants.

1,334,093. Telephone-Transmitter Mouthpiece; Jonathan W. Harris, Montclair, N. J. App. filed Oct. 18, 1916. Porcelain body with metal adapter.

1,334,095. Ignition System for Internal-Combustion Engines; George H. Hill (deceased), late of Schenectady, N. Y. App. filed Nov. 5, 1917. Increases spark.

1,334,105. Switch-Controlling System; Alben E. Lundell, New York, N. Y. App. filed June 21, 1916. Places driving circuit under control of electromagnetic speed-controlling device.

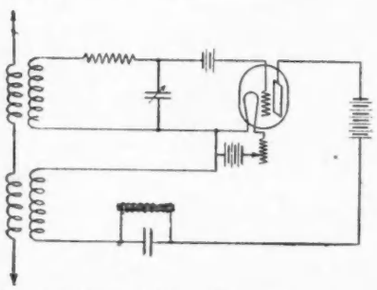
1,334,118. System for Amplification of Small Currents; Chester W. Rice, Schenectady, N. Y. App. filed July 31, 1917. Use of electron discharge relays, detectors or amplifiers for receiving radio signals.

1,334,122. Telegraph System; Adolph R. Swoboda, Newark, N. J. App. filed May 11, 1918. Overcoming zero effects in telegraphic conductors having high electrostatic capacity.

1,334,125. Telephone-Exchange System; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Aug. 12, 1918. Call-distributing type.

1,334,126. Means for Controlling Alternating Currents; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed April 11, 1918. Control flow of high-frequency currents in circuit or multiply frequency.

1,334,139. Condenser; William Dubilier New York, N. Y. App. filed Aug. 1, 1918. Prevents failure of insulation at any point.



No. 1,334,165. Electric-Wave Transmission

1,334,140. Condenser and Method of Adjusting the Same; William Dubilier, New York, N. Y. App. filed Aug. 1, 1918. Without damaging elements.

1,334,141. Insulating-Testing Device; William Dubilier, New York, N. Y. App. filed Aug. 26, 1918. Tests dielectric strength and exposes imperfections.

1,334,142. Condenser-Plate Construction; William Dubilier, New York, N. Y. App. filed April 11, 1919. Tough and durable plate, the edge of which is used as terminal.

1,334,146. X-Ray Tube; Francis J. Farrelly and Alfred Greiner, Hartford, Conn. App. filed Oct. 27, 1917. Path of electrical conduction between exterior of positive and negative ends of an X-ray tube.

1,334,150. Electrical Discharge Tube; Charles E. Green and John H. Clough, Schenectady, N. Y. App. filed July 11, 1916. Feeble discharge utilized to prime tube for a heavier discharge.

1,334,160. Continuous Electrical Mechanical Filter; Archibald F. Meston, New York, N. Y. App. filed Feb. 23, 1918. Successively interposes filtering media in path of movements.

1,334,165. Electric-Wave Transmission; Michael I. Pupin, Norfolk, Conn. App. filed Sept. 17, 1915. Production of negative resistance reaction by a system of circuits and its application to compensation of resistance reaction of electrical conductors in order to make them responsive to sustained electrical waves of a predetermined frequency and not responsive to electromotive forces of a disturbing character.

1,334,172. Automatic Closure for Conduit Boxes; Charles S. Ryerson, Norfolk, Va. App. filed Aug. 31, 1918. Spring holds cover.

1,334,258. Electromagnetic Device; Gustave Plaisant, Ealing, London, England. App. filed July 15, 1919. Deflects magnetic lines of force.